

Water Sample Data Documentation

Introduction

During OMEX II a total of 991 different parameters were measured on water samples by 30 principal investigators using a wide range of protocols. The aim of this document is to allow the protocol used to obtain any particular data value within the BOTDATA table to be determined with ease.

To help you find the information you require quickly, the document is subdivided into sections that describe groups of closely related parameters. These are listed below as a series of hot links. Each section starts with the definition of the parameter codes covered, followed by a list of who measured one or more of those parameters by cruise. Next, there is a protocol section describing the methods used by each principal investigator. Finally, there may be comments on data quality that have been noted by BODC or have come to our attention.

<TIP> If you want to find out how a particular parameter was measured and know the parameter code then the fastest way to find the information you require is to use the *Acrobat* 'find' tool to search for the parameter code. Then use the 'find' tool again to search for the name of the principal investigator. This will take you straight to the protocol description you require.

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References

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Nutrients

Parameter code definitions

AMONAAD2	Dissolved ammonium Colorimetric autoanalysis (0.4/0.45 µm pore filtered) Micromoles/litre
AMONAAD5	Dissolved ammonium Colorimetric autoanalysis (0.2 µm pore filtered) Micromoles/litre
AMONAATX	Dissolved ammonium Colorimetric autoanalysis (unfiltered) Micromoles/litre
AMONMATX	Ammonium (unfiltered) Manual Colorimetric analysis (unfiltered) Micromoles/litre
NTRIAAD2	Dissolved nitrite Colorimetric autoanalysis (0.4/0.45 µm pore filtered) Micromoles/litre
NTRIAAD5	Dissolved nitrite Colorimetric autoanalysis (0.2 µm pore filtered) Micromoles/litre
NTRIAATX	Nitrite (unfiltered) Colorimetric autoanalysis (unfiltered) Micromoles/litre
NTRZAAD2	Dissolved nitrate + nitrite Colorimetric autoanalysis (0.4/0.45 µm pore filtered) Micromoles/litre
NTRZAAD5	Dissolved nitrate + nitrite Colorimetric autoanalysis (0.2 µm pore filtered) Micromoles/litre
NTRZAATX	Nitrate + nitrite (unfiltered) Colorimetric autoanalysis (unfiltered) Micromoles/litre
PHOSAAD2	Dissolved phosphate Colorimetric autoanalysis (0.4/0.45 µm pore filtered) Micromoles/litre

PHOSAAD5	Dissolved phosphate Colorimetric autoanalysis (0.2 µm pore filtered) Micromoles/litre
PHOSAATX	Phosphate (unfiltered) Colorimetric autoanalysis (unfiltered) Micromoles/litre
PHOSMATX	Phosphate (unfiltered) Manual Colorimetric analysis (unfiltered) Micromoles/litre
SLCAAAD2	Dissolved silicate Colorimetric autoanalysis (0.4/0.45 µm pore filtered) Micromoles/litre
SLCAAAD5	Dissolved silicate Colorimetric autoanalysis (0.2 µm pore filtered) Micromoles/litre
SLCAAATX	Silicate (unfiltered) Colorimetric autoanalysis (unfiltered) Micromoles/litre
SLCAMATX	Silicate (unfiltered) Manual Colorimetric analysis (unfiltered) Micromoles/litre
UREAMDD2	Dissolved urea Manual analysis using the diacetylmonoxime method (0.4/0.45 µm pore filtered) Micromoles/litre
UREAMDTX	Urea (unfiltered) Manual analysis using the diacetylmonoxime method Micromoles/litre

Originator code definitions

Charles Darwin cruise CD105B

14	Dr. Lei Chou	ULB, Brussels, Belgium
62	Mr. Malcolm Woodward	Plymouth Marine Laboratory, UK
112	Dr. X. A. Alvarez-Salgado	IIM, Vigo, Spain

Charles Darwin cruise CD110B

112 Dr. X. A. Alvarez-Salgado IIM, Vigo, Spain

Charles Darwin cruise CD114A

62 Mr. Malcolm Woodward Plymouth Marine Laboratory, UK
112 Dr. X. A. Alvarez-Salgado IIM, Vigo, Spain

Charles Darwin cruise CD114B

62 Mr. Malcolm Woodward Plymouth Marine Laboratory, UK

Belgica cruise BG9714B

10 Ir. Marc Elskens VUB, Brussels, Belgium
14 Dr. Lei Chou ULB, Brussels, Belgium
62 Mr. Malcolm Woodward Plymouth Marine Laboratory, UK

Belgica cruises BG9714C and BG9815C

10 Ir. Marc Elskens VUB, Brussels, Belgium
14 Dr. Lei Chou ULB, Brussels, Belgium
112 Dr. X. A. Alvarez-Salgado IIM, Vigo, Spain

Belgica cruises BG9714D, BG9815D and BG9919A

14 Dr. Lei Chou ULB, Brussels, Belgium

Belgica cruises BG9919B and BG9919C

10 Ir. Marc Elskens VUB, Brussels, Belgium
14 Dr. Lei Chou ULB, Brussels, Belgium

Pelagia cruises PLG109 and PLG138

11 Dr. Wim Helder NIOZ, Texel, the Netherlands

Poseidon PS237_1

135 Dr. Rolf Peinert Kiel University, Germany

Professor Shtokman cruise ST0898

112 Dr. X. A. Alvarez-Salgado IIM, Vigo, Spain
134 Dr. Antonio Bode IEO, La Coruña, Spain

Thalassa cruise TH1099

134 Dr. Antonio Bode IEO, La Coruña, Spain

Almeida Carvalho cruise AC97

167 Dr. João Vitorino

Instituto Hidrografico, Portugal

Meteor cruise M43_2

13 Dr. Axel Miller

Plymouth Marine Laboratory, UK

73 Prof. Robin Keir

GEOMAR, Kiel, Germany

Originator protocols

Dr. Lei Chou

Manual spectrophotometric analyses for phosphate and silicate were done using the methods specified in Grasshoff et al. (1983). These analyses were usually carried out on board ship as soon after sampling as possible. Samples were kept refrigerated and dark between collection and analysis.

Samples for nutrient determination by autoanalysis were kept frozen until analysed. A separate set of samples were usually taken specifically for silicate analysis and stored in the dark, chilled but not frozen. Samples were analysed on a SKALAR autoanalyser.

Dr. Xosé A. Alvarez-Salgado

Different sampling strategies were employed on different cruises. Logistics for CD110B and BG9815C allowed analysis of the samples at sea. In these cases, the samples were drawn from the CTD bottles into 50ml polyethylene containers and preserved at 4°C until they were analysed on board. For other cruises the samples were filtered through Whatman polypropylene filters (0.45µm pore size) into 50ml polyethylene containers and preserved by freezing at -20°C until analysed in the laboratory at IIM.

In both cases, nutrient concentrations were determined colorimetrically using an Alpkem Corporation auto-analyser, working under the principle of Segmented Flow Analysis (SFA).

The data were generally supplied to BODC in units of micromoles per kilogram (converted by the originator assuming a density of 1.025 kg/litre) with nitrate and nitrite supplied as separate channels. These have been converted to units of micromoles/litre (by multiplying by 1.025) and NO₃ and NO₂ have been added to give a NO₃+NO₂ channel. The exception was the data from CD114A that were supplied in intercalibration format with NO₂ and NO₃+NO₂ in units of micromoles per litre. These data have been loaded to the database unmodified.

Mr. Malcolm Woodward

Water samples were sub-sampled directly from the CTD bottles into clean Nalgene bottles. Analysis was carried out on board ship, and completed within 3 hours of sampling in every case

Inorganic nutrient concentrations were determined using a 5-channel Technicon AAll, segmented flow analyser. The methodologies used for each nutrient followed those of Brewer and Riley (1965) for nitrate, Grasshoff (1976) for nitrite, Kirkwood (1989) for phosphate and silicate, and Mantoura and Woodward (1983) for ammonia.

During CD114B, when concentrations dropped below the detection limits for the colorimetric system, a nanomolar Ammonia analysis system (adapted from Jones, 1991) and nanomolar chemiluminescence system for nitrate and nitrite (Garside, 1982) were used. Note that there was no indication in the data set of the system used for each individual sample. Consequently, all data in the database have been coded as if they were determined using the Technicon system.

For the primary production stations during cruise CD114, 60ml samples for the analysis of urea were filtered through acid rinsed 0.45µm filters, frozen and stored at -20°C. They were subsequently analysed in the laboratory by the method described by Goeyens et al. (1998).

The data from some cruises were supplied in units of micromoles/kg. These had been converted using a nominal density of 1.025 kg/litre. The data were converted back to micromoles/litre before they were loaded to the database.

Dr. Rolf Peinert

Samples were taken from CTD bottles for analysis of nutrient concentrations by means of an autoanalyser on board ship, as soon as possible after collection.

Dr. Wim Helder

Samples were taken from CTD bottles into polyethylene bottles, filtered through a 0.2µm acrodisc filter and analysed within 10 hours. Nutrient concentrations were determined colorimetrically, following the methods described by Grasshoff (1983) using a Bran and Luebbe Traacs 800 Autoanalyser. Samples were always analysed from the surface to the bottom to minimise the risk of cross-sample contamination.

Working standards were freshly prepared daily by diluting stock standards to the required concentration with natural, aged, low-nutrient seawater. The nutrient concentrations in this were determined by manual Colorimetric analysis. The low-nutrient seawater was also used as a wash between samples. A second mixed nutrient stock, poisoned with 0.2% chloroform or 20 mg/l HgCl₂, was used as an independent check. Pipettes and volumetric

flasks were calibrated before each cruise and standard batches were intercalibrated.

Accuracy of analyses is reported as about 1% of the full-scale value for nitrate, nitrite and silicate and 2% of the full scale for phosphate and ammonium.

The data were supplied to BODC as nitrate (corrected for nitrite) and nitrite. A nitrate+nitrite channel was generated by summing NO_2 and NO_3 . The data from some cruises were supplied in units of micromoles/kg. The true density was used to convert these to micromoles/litre.

Dr. Antonio Bode

Samples were transferred from CTD bottles into polyethylene tubes and immediately frozen. Nutrient analyses were carried out in the laboratory of IEO, using a Technicon AAll autoanalyser, with colorimetric methods described by Grashoff (1983).

The data were supplied to BODC as nitrate (corrected for nitrite) and nitrite. A nitrate+nitrite channel was generated by summing NO_2 and NO_3 .

Ir. Marc Elskens

Nutrient concentrations were determined on unfiltered samples from CTD bottles. Nitrate+nitrite and silicate were analysed with a Technicon Auto Analyser II, and ammonium and urea were determined with manual colorimetric methods. The ammonium analyses were carried out according to Koroleff (1969), with indophenol blue, and urea with the diacetyl-monoxime method according to Goeyens et al. (1998).

Dr. Axel Miller

CTD bottle samples were frozen immediately after collection in Nalgene plastic bottles. The samples were transported over land from Cadiz to Plymouth packed in dry ice, but they may have defrosted in transit. Nitrate plus nitrite concentrations were determined using automated colorimetric analysis based on the cadmium reduction method. The analyses were completed approximately one month after sample collection.

Prof. Robin Keir

Manual spectrophotometric analyses for phosphate were done using the methods specified in Grasshoff et al. (1983). These analyses were carried out on board ship as soon after sampling as possible. Samples were kept refrigerated and dark between collection and analysis.

Comments on Data Quality

The following comments on data quality were either included in the cruise report by the analyst or notes made during the BODC data audit.

CD105B

The determination of ammonia concentrations was problematic due to the contamination of the Milli-Q system onboard, which prevented a reliable baseline being established.

CD110B

The Alpkem Corporation analyser performed with a high degree of accuracy during the cruise.

CD114 legs A and B

The Technicon produced reliable and reproducible data throughout the cruise. The chemiluminescent system for analysis of nanomolar concentrations of nitrate/nitrite worked well, but concentrations were close to the limits of detection in the well-mixed layer of oligotrophic stations.

AC97

The ammonia data do not look reliable: there are lots of zero values with sudden jumps up to values as high as 1.6. High variance was noted in the silicate data for some stations.

BG9919 (all legs)

The silicate analyses were carried out on frozen samples over a year after the cruise, as no chilled samples were available. Users are therefore requested to treat the silicate data from all legs of this cruise with caution.

Nutrient Intercalibration

Many efforts were made during the period of OMEX II-II to compare nutrient data produced from different laboratories. The 'formal' Work Package 4 intercalibration was based on samples collected during two contemporaneous cruises in June 1997. The following is summarised from the intercalibration report.

Intercalibration samples were taken from cruise CD105B and analysed by Plymouth Marine Laboratory, the Instituto de Investigações Marias (IIM) and University of Brussels (ULB). At Stations S90, S200 and S2250, samples were taken from the CTD bottle, filtered through acid-washed, 0.45 µm cellulose nitrate filters and then sub-sampled. One sub-sample was analysed onboard Charles Darwin, and four were immediately frozen. Of these, three

were transferred to Belgica (BG9714B) for analysis, and one was returned to PML for later analysis. On 20/06/97, simultaneous CTD casts were made from Charles Darwin and Belgica, and 24 replicate samples were analysed on both ships.

The following table summarises the results of the comparison between PML and IIM:

	Slope	Y Intercept	R ²
Nitrate	1.04	0.00	1.00
Phosphate	0.85	0.01	0.92
Silicate	0.70	-0.47	0.98
Ammonium	0.27	0.22	0.11

A regression of the nitrate concentrations determined by the two laboratories shows almost perfect agreement with a slope of 1.04 for the fitted line, an intercept of zero and an R² value of 1.00. The phosphate intercalibration was also good with R² of 0.85. However, the slope was no longer unity and the IIM estimates were higher than those of the PML. The R² value for the silicate determinations suggests that the precision of both laboratories is good (the regression yields a straight line with R² value of 0.98), but there is a problem with accuracy. In other words, the relative changes in silicate concentration were well described by both laboratories but there is doubt about the absolute value of silicate concentration, with the PML consistently measuring lower concentrations than the IIM. Finally, the analysis of ammonium shows wide variations with the IIM estimates being higher than the PML estimates. However, in the case of ammonium, both precision and accuracy were suspect. This may be a consequence of storage of samples or of contamination on board ship, which is a recognised problem in ammonium determinations.

There was excellent agreement between the phosphate measurements made by the ULB and the PML. The slope of the fitted line was 1.09, the intercept was -0.01 and the R² was 0.99. That is, precision and accuracy were both excellent in these measurements. The silicate data also showed a perfect linear trend with an R² value of 1.00. However, as with the intercalibration of the PML and the IIM, the slope was not unity and the PML estimates were consistently below those obtained by ULB. It is clear that the PML standard silicate solution was not correct

There were a number of other cruises when analysts were present from more than one laboratory and cross-checked results from common samples. Both PML and IIM participated in CD114 and samples collected on ST0898 were analysed by both IEO and IIM. All versions of the data have been loaded into the database and may be retrieved for comparison if required.

Ammonium Oxidation Rate

Parameter Code Definitions

AMOXRCTX Ammonium oxidation (nitrification) rate
Difference between ^{14}C uptake by dark-incubated samples with
and without a nitrification inhibitor
Nanomoles per litre per hour

AMXERCTX Ammonium oxidation (nitrification) rate standard error
Difference between ^{14}C uptake by dark-incubated samples with
and without a nitrification inhibitor
Nanomoles per litre per hour

Originator Code Definitions

Charles Darwin cruise CD114B

3 Dr. Ian Joint

Plymouth Marine Laboratory, UK

Originator Protocols

Dr. Ian Joint

The incorporation of ^{14}C in the dark with and without the presence of a nitrification inhibitor, allylthiourea (ATU), was determined as follows. At selected depths 6 x 100ml polycarbonate bottles were filled with seawater. Approximately 10 μCi of ^{14}C bicarbonate was added to each, then to three of the bottles ATU was added to a final concentration of 10 mg l^{-1} . Incubations were in the dark at ambient temperature for approximately 6 hours and were terminated by filtration onto 0.2 μm polycarbonate filters, which were then dried over silica gel desiccant prior to analysis by liquid scintillation counter onboard ship.

Carbon incorporation was converted to ammonium oxidation according to Owens (1986).

The standard errors were calculated by propagation of the errors in both treatment groups (i.e. with and without nitrification inhibitor). The rates were found to be variable with large associated errors. Negative values in the data set have been set zero as requested by the data originators. The originators advise that these data should be used with **caution**. It is recommended that potential users of the data should consult them (Ian Joint or Andy Rees).

Particulate Total Carbon, Organic Carbon, Total Nitrogen and Silica

Parameter definitions

CORGCAP1	Particulate organic carbon (acidified) Acid fumed then C/N analyser (GF/F filtered) Micromoles/litre
CORGCNP1	Particulate organic carbon (unacidified) Carbon/nitrogen analyser (GF/F filtered) Micromoles/litre
ICCNCNPC	Inorganic carbon content (centrifuged SPM) Difference between C/N analyser results on total and acidified samples (centrifuged) Per cent
NTOTCNP1	Particulate total nitrogen ("PON") Carbon/nitrogen analyser (GF/F filtered) Micromoles/litre
NTOTMSP1	Particulate total nitrogen ("PON") Mass spectrometry Micromoles/litre
OCCNCAP1	Organic carbon content (GF/F filtered SPM) Acidification then carbon/nitrogen analyser (GF/F filtered) Per cent
OCCNCAP2	Organic carbon content (0.45 micron pore filtered SPM) Acidification then carbon/nitrogen analyser (0.4/0.45 µm pore filtered) Per cent
OCCNCAPC	Organic carbon content (centrifuged SPM) Acidification then carbon/nitrogen analyser (centrifuged) Per cent
OPALWCP7	Particulate opaline silica NaOH hydrolysis of material trapped on a cellulose acetate filter Micromoles/litre
TCCNCNP2	Total carbon content (0.45 micron pore filtered SPM) Carbon/nitrogen analyser (0.4/0.45 µm pore filtered) Per cent

TNCNCNP2 Total nitrogen content (0.45 micron pore filtered SPM)
Carbon/nitrogen analyser (0.4/0.45 µm pore filtered)
Per cent

TNCNCNPC Total nitrogen content (centrifuged SPM)
Carbon/nitrogen analyser (centrifuged)
Per cent

Originator Code Definitions

Almeida Carvalho cruises AC97, AC99 and CORVET

91 Dr. Aurora Rodrigues Instituto Hidrografico, Portugal

Belgica cruises BG9714C, BG9815C, BG9919B and BG9919C

10 Ir. Marc Elskens VUB, Brussels, Belgium

14 Dr. Lei Chou ULB, Brussels, Belgium

Belgica cruises BG9714D, BG9815D and BG9919A and Charles Darwin cruise CD110B

14 Dr. Lei Chou ULB, Brussels, Belgium

Pelagia cruise PLG121

96 Dr. Laurenz Thomsen GEOMAR, Kiel, Germany

Poseidon Cruise PS237_1

135 Dr. Rolf Peinert Kiel University, Germany

Meteor cruise M43_2

96 Dr. Laurenz Thomsen GEOMAR, Kiel, Germany

135 Dr. Rolf Peinert Kiel University, Germany

Charles Darwin cruise CD105B

15 Prof. Nick McCave Cambridge University, UK

Charles Darwin cruises CD114A and CD114B

112 Dr. X. A. Alvarez-Salgado IIM, Vigo, Spain

Professor Shtokman cruise ST0898 and Thalassa cruise TH1099

134 Dr. Antonio Bode IEO, La Coruña, Spain

Originator protocols

Ir. Marc Elskens

Seawater samples from Niskin bottles were filtered on pre-combusted Whatman GF/F filters. The filters were air-dried at 60°C and kept at room temperature until analysed. The samples were treated with HCl vapour to remove carbonates and analysed using a Carlo Erba NA1500 elemental analyser. The CO₂ and N₂ were separated by means of a gas chromatographic column (Poropak QS) and measured by thermal conductivity detection.

Dr. Lei Chou

CTD and Non-toxic sample collection

Approximately two litres of water were filtered through glass fibre (GF/F) filters (47 mm), which had been pre-ashed at 500°C for 4 hours. The filters were kept frozen until analysed.

SAP collection

Challenger Oceanics in-situ stand-alone pumps (SAPs) were used to sample particulate material. A programmable timer ensured that the pump only operated when in position at the desired depth. Membrane filters with a 0.4-micron pore size were used to collect the particulate material. On recovery the filters were rinsed and dried in clean conditions.

GPCENT collection.

Suspended particulate matter was collected by continuous flow centrifugation using an Alpha-Laval oil purifier (model MAB 104) specially coated for oceanographic use. Water supply was adjusted to approximately 1 cubic metre per hour. Samples were collected both when the ship was on station and steaming between stations for about 6-10 hours. In OMEX II most of the samples were collected on station.

Samples were taken from the centrifuge body using a stainless steel spatula, stored in acid-washed PET vials and immediately deep frozen. After weighing (wet weight) the sample was subdivided for C/N, trace metal and isotope analysis.

Analysis

The samples were acidified to remove carbonates and then assayed in an Interscience NA-2000 elemental particulate analyser. Total carbon content was determined where sufficient material was available by analysing an additional unacidified sample. The data were supplied in units of mg/l. Carbon

and nitrogen were converted to μM by dividing by 12.011 and 14.007 respectively, then multiplying by 1000.

Dr. Xosé A. Alvarez-Salgado

Samples were collected from Niskin bottles in 2-litre polycarbonate flasks. They were immediately filtered using an oil-less filtration system to collect the particulate organic matter on 25 mm Whatman GF/F filters (ashed for 4 hours at 450°C). The filters were dried on silica gel and frozen to -20°C until analysis was carried out in the laboratory at IIM. Total carbon determinations were performed using a "Perkin Elmer 2400 CHN" analyser on unacidified samples.

Dr. Aurora Rodrigues

Water samples were taken from CTD bottles and filtered through pre-ashed Whatman GF/F filters. Organic carbon was determined at the University of Bordeaux using the method of Strickland and Parsons (1972) as adapted by Etcheber (1982). Samples were treated with 2N HCl to remove carbonates and assayed using a LECO CS-125 analyser.

The data were supplied as SPM concentration in mg/l and organic carbon content, expressed as a percentage. These parameters were stored, but in addition a POC concentration was computed and stored, using the equation:

$$\text{POC } (\mu\text{M}) = (\text{SPM} * \% \text{ Organic carbon} * 10) / 12.011$$

Dr. Laurenz Thomsen

Water samples were collected using the BIOPROBE benthic water sampling lander (Thomsen et al., 1994). This was gently positioned on the seabed with approximately 20m of slack cable. A graduated rod, monitored by a video camera, determined penetration into the sediment, enabling precise sampling heights to be determined.

A timer switched on the sampling pumps after any sediment stirred up by the landing had dispersed. Sampling inlets were positioned at different heights on the instrument enabling water at different heights from the seabed to be collected. The samples were stored in a series of coiled plastic tubes, each having a capacity of 10 litres.

The water samples were filtered on GF/F filters, acidified to remove carbonates and analysed using a Heraeus CHN analyser. Further details of the protocol are given in Thomsen and Graf (1995).

The data were supplied in units of $\mu\text{g/l}$. Carbon and nitrogen were converted to μM by dividing by 12.011 and 14.007 respectively.

Two litres of water were filtered through pre-combusted GF/F filters. The samples were returned to the laboratory where carbon and nitrogen were determined using a CHN analyser.

The data were supplied in units of $\mu\text{g/l}$. This was converted to μM through division by 12.01 for carbon and 14.007 for nitrogen.

Dr. Rolf Peinert

Water samples were taken from the bottles on the CTD rosette. Aliquots were filtered through pre-ashed GF/F filters for carbon determinations and cellulose acetate filters for biogenic silica determinations. Organic carbon was determined on samples with the inorganic carbon removed using a CHN analyser. Biogenic silica was determined by wet chemical methods after hydrolysis of the sample.

The data were supplied in units of $\mu\text{g/l}$. This was converted to μM through division by 12.01 for carbon and 14.007 for nitrogen.

Dr. Antonio Bode

Samples were taken at the beginning (after ^{15}N inoculation) of DON excretion experiments by filtration through Millipore AF glass fibre filters. The samples were frozen until analysed back in the laboratory using an Integra-N isotope-ratio mass spectrometer.

Dissolved Organic Carbon and Total Nitrogen

Parameter Code Definitions

CORGCOD1	Dissolved organic carbon High temperature Pt catalytic oxidation (GF/F filtered) Micromoles/litre
NTOTCOD1	Dissolved total nitrogen High temperature Pt catalytic oxidation (GF/F filtered) Micromoles/litre
NTOTWCD1	Dissolved total nitrogen Oxidation then autoanalysis (GF/F filtered) Micromoles/litre
SEOCCOD1	Dissolved organic carbon standard error High temperature Pt catalytic oxidation (GF/F filtered) Micromoles/litre
SETNCOD1	Dissolved total nitrogen standard error High temperature Pt catalytic oxidation (GF/F filtered) Micromoles/litre

Originator Code Definitions

Charles Darwin cruise CD110B, Meteor cruise M43_2 and Belgica cruise BG9919B

13	Dr. Axel Miller	Plymouth Marine Laboratory, UK.
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Professor Shtokman cruise ST0898

13	Dr. Axel Miller	Plymouth Marine Laboratory, UK.
134	Dr. Antonio Bode	IEO, La Coruña, Spain

Charles Darwin cruises CD114A and CD114B

112	Dr. X. A. Alvarez-Salgado	IIM, Vigo, Spain
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Thalassa cruise TH1099

134	Dr. Antonio Bode	IEO, La Coruña, Spain
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Originator Protocols

Dr. Axel Miller

Samples were taken from the CTD rosette or non-toxic supply and filtered through GF/F filters. The filtrates were acidified, transferred to flame-sealed, pre-ashed glass ampoules and stored in a refrigerator until analysed. Ultra-clean handling techniques were used throughout.

The analytical technique involves the direct injection of acidified and decarbonated seawater onto a platinised alumina catalyst at high temperature (680-900°C) under an atmosphere of oxygen or high purity air. Quantitative production of CO₂ gas allows DOC concentrations to be determined using a CO₂-specific infrared gas analyser (IRGA).

A Shimadzu TOC-5000 HTOC analyser was used. This was fitted with a LiCor Li6252 IRGA for DOC determination and Antek 705-D chemiluminescence detector for TDN determination. The combustion products travelled through a Drierite trap (97% CaSO₄, 3% CoCl₃) and a membrane (permeation tube) drier to remove any trace of water. Each sample was injected four times with each injection cycle taking 5.5 minutes.

Great care was taken to quantify blank signals generated at all stages of the analytical procedure and to correct the data for them. A more detailed description of the protocols followed may be found in Miller et al. (1993).

Dr. Xosé A. Alvarez-Salgado

Samples were filtered through glass fibre (GF/F) filters. The filtrates were collected into 10ml ampoules, acidified with H₃PO₄ and then heat-sealed. They were preserved in the dark at 4°C until analysed in the laboratory at IIM. A Shimadzu TOC 5000 analyser was coupled in-series with an Antek 7020 chemiluminescence detector for the simultaneous determination of DOC and TDN. High temperature (680°C) catalytic (Al₂O₃ impregnated with 0.5% platinum) oxidation quantitatively produced CO₂ and NO_x. These were determined with an NDIR gas analyser and an N-specific chemiluminescence reaction respectively.

Dr. Antonio Bode

Samples were taken at the beginning (after ¹⁵N inoculation) of DON excretion experiments and filtered through Millipore AF glass fibre filters. The samples were frozen until analysed back in the laboratory using a Technicon AA-II autoanalyser after wet chemical oxidation to convert the organic nitrogen to inorganic.

Notes on Data Quality

Some of the TDN values from CD110 and ST0898 were up to 5 μ M lower than the corresponding nitrate+nitrite values from the nutrient data set.

A significant proportion of the TDN data from M43_2 was flagged as suspect by the data originator, with very good reason. Users are therefore advised not to ignore the quality control flags when using the data.

DOC/DON Rate Parameters

Parameter Code Definitions

- DCPERIP1 Dissolved organic carbon production standard error
Tracer activity remaining in ^{14}C -doped, incubated, GF/F filtered
and acidified water sample
Milligrams/metre cube/hour
- DNEXSOXX Dissolved organic nitrogen (DON) excretion (on-deck simulated
in-situ conditions)
 ^{15}N -doped, incubated at simulated in-situ light and processed
according to Slawyk and Raimbault (1995)
Nanomoles per litre per hour
- DOCPRIP1 Dissolved organic carbon production
Tracer activity remaining in ^{14}C -doped, incubated, GF/F filtered
and acidified water sample
Milligrams/metre cube/hour
- DOCUCOBC Bacterial dissolved organic carbon uptake
Incubation experiment on $0.8\mu\text{m}$ filtered water.
DOC determined by Pt HTCO
Micromoles per litre per hour
- NARESOXX Ammonium regeneration (on-deck simulated in-situ conditions)
 ^{15}N -doped, incubated at simulated in-situ light and processed
according to Slawyk and Raimbault (1995)
Nanomoles per litre per hour

Originator Code Definitions

Professor Shtokman cruise ST0898

- | | | |
|-----|----------------------|--|
| 134 | Dr. Antonio Bode | IEO, La Coruña, Spain |
| 143 | Dr. Helena Galvão | UCTRA, University of the Algarve, Portugal |
| 173 | Pr. Emilio Fernández | University of Vigo, Spain |

Charles Darwin cruise CD110B

- | | | |
|-----|----------------------|---------------------------|
| 173 | Pr. Emilio Fernández | University of Vigo, Spain |
|-----|----------------------|---------------------------|

Belgica cruises BG9919B and BG9919C

- | | | |
|-----|-------------------|--|
| 143 | Dr. Helena Galvão | UCTRA, University of the Algarve, Portugal |
|-----|-------------------|--|

Thalassa cruise TH1099

134	Dr. Antonio Bode	IEO, La Coruña, Spain
173	Pr. Emilio Fernández	University of Vigo, Spain

Originator Protocols

Dr. Helena Galvão

Water samples were filtered through 0.8-micron filters and incubated for four hours at an average temperature of 19°C. The DOC concentration was determined at the start and end of the experiment by the PML group using high temperature catalytic oxidation.

Dr. Antonio Bode

Duplicate samples were taken from the Niskin bottles, placed in polycarbonate bottles, inoculated with trace concentrations of $(^{15}\text{NH}_4)_2\text{SO}_4$ and incubated at simulated in-situ light conditions in an on-deck incubator.

Incubations were terminated by filtration through Millipore AF glass fibre filters. Both the particulate material and the filtrate were preserved for the determination of particulate and dissolved nitrogen concentrations and ^{15}N enrichment.

Initial nitrogen concentrations were determined from two replicates that were inoculated and then filtered immediately.

All samples were frozen until processed following the methods of Slawyk and Raimbault (1995) back in the laboratory. Inorganic nitrogen was determined following the methods of Grasshoff et al. (1983) using a Technicon AAll autoanalyser. ^{15}N enrichment was determined using an isotope-ratio mass spectrometer.

Pr. Emilio Fernández

Seawater samples were collected from bottles on the CTD rosette. 30ml aliquots were inoculated with 1295 KBq (10 μCi) of $\text{NaH}^{14}\text{CO}_3$ and incubated in an on-deck incubator for two hours. Two 8ml sub-samples were drawn from each bottle and filtered through Millipore APFF glass fibre filters. The filtrates were acidified with 40 μl of 50% HCl and bubbled with CO_2 -free air for 12 hours. The filters were fumed using concentrated HCl to remove any carbonates. Activity levels in both filters and filtrates was determined by the addition of scintillation cocktail and counting on an LKB beta-scintillation counter.

Carbonate System Parameters

Parameter Code Definitions

ALKYPOTX Total alkalinity
Potentiometry
Micro-equivalents per litre

PCO2C101 pCO₂
Computed from pH and alkalinity
Parts per million

PHXXPR01 pH
pH electrode
pH scale per litre

TCO2C1TX Total dissolved inorganic carbon (TCO₂)
Computed from pH and alkalinity
Micromoles/litre

TCO2CAD2 Total dissolved inorganic carbon (TCO₂)
Quantification of acid-liberated CO₂ using a CO₂ analyser
Micromoles/litre

TCO2CBD5 Total dissolved inorganic carbon (TCO₂)
Quantification of acid-liberated CO₂ using indicator photometry
(0.2 micron filtered)
Micromoles/litre

Originator Code Definitions

Belgica cruises BG9714B, BG9714C, BG9714D, BG9815B, BG9815C, BG9815D, BG9919A, BG9919B and BG9919C, Charles Darwin cruises CD110B, CD114A and CD114B and Meteor cruise M43 2.

69 Dr. Michel Frankignoulle University of Liège, Belgium

Poseidon cruise PS237 1

73 Prof. Robin Keir GEOMAR, Kiel, Germany

Pelagia cruise PLG109

11 Dr. Wim Helder NIOZ, Texel, the Netherlands

Originator Protocols

Dr. Michel Frankignoulle

pH was measured using a combined ROSS electrode and is calibrated on the total proton scale using buffers proposed by Dickson (1993). The error on the pH is estimated to 0.005 pH units.

Total alkalinity was determined by electrotitration (Gran method). Errors on measured alkalinity are estimated to 4 $\mu\text{Eq/kg}$.

Carbon dioxide speciation (TCO_2 and pCO_2) has been calculated from alkalinity and pH using CO_2 constants from Roy et al. (1993). The borate constant was from Dickson (1990). The carbon dioxide solubility coefficient was from Weiss (1974). The error on pCO_2 was estimated to be 8-10 ppm.

Further details of the methods used are given in Frankignoulle et al. (1986, 1996).

The alkalinity and TCO_2 data were supplied in units of mEq/kg and millimoles/kg. BODC standard practice is to store parameters in units per litre together with a conversion factor derived from in-situ pressure, temperature and salinity (TOKGPR01) that effects the conversion from litres to kilograms. The database units for these parameters are micromoles rather than millimoles. Consequently, the data supplied had the following transform applied:

$$\text{Database value} = (\text{Original value} * 1000)/\text{TOKGPR01}$$

The pH units supplied were also in terms of per kilogram. The following transform was applied to convert the data into a concentration per litre:

$$\text{Database value} = -1.0 * \log_{10}(10^{**}((\text{Original value} * -1)/\text{TOKGPR01}))$$

Prof. Robin Keir

Samples were taken from CTD rosette bottles and returned to Kiel for analysis. Carbon dioxide was liberated by adding orthophosphoric acid, trapped at liquid nitrogen temperatures and purified by distillation and trapping at controlled temperature. The quantity of CO_2 liberated was determined using a LiCOR carbon dioxide analyser.

The data were supplied in units of micromoles/kg. These were converted to micromoles/litre through application of the following transform:

$$\text{Database value} = \text{Original value}/\text{TOKGPR01}$$

Dr. Wim Helder

Water samples were filtered through 0.20 or 0.45 micron pore filters. The filtrates were taken into a primary acidified stream, which converted all carbonates and bicarbonates to CO₂. The liberated gas passed through a membrane into a secondary stream containing phenolftaleine at pH 9-10. The CO₂ reduced the pH in this stream, weakening the purple colour of the indicator. This was quantified spectrophotometrically at 520 nm.

The data were supplied in units of micromoles/kg. These were converted to micromoles/litre through application of the following transform:

$$\text{Database value} = \text{Original value} / \text{TOKGPR01}$$

Inorganic Carbon-13 Enrichment

Parameter Code Definitions

D13CMITX	Total inorganic carbon (TCO ₂) ¹³ C enrichment (δ ¹³ C) Mass spectrometry on acid-liberated CO ₂ Parts per thousand
S13CMITX	Total inorganic carbon (TCO ₂) ¹³ C enrichment (δ ¹³ C) standard error Mass spectrometry on acid-liberated CO ₂ Parts per thousand

Originator Code Definitions

Belgica cruises BG9714C and BG9815C, Poseidon cruise PS237_1 and Meteor cruise M43_2

73 Prof. Robin Keir GEOMAR, Kiel, Germany

Originator Protocols

Prof. Robin Keir

Water samples were drawn from the CTD rosette and returned to Kiel for analysis. The isotopic composition of the inorganic carbon was determined by acidifying with orthophosphoric acid. The CO₂ liberated was stripped by high purity nitrogen and trapped in a loop immersed in liquid nitrogen under rough vacuum. The gas was separated from water vapour by distillation and trapping at controlled temperatures. The purified CO₂ was then analysed using a Finnigan-MAT Delta E gas isotope mass spectrometer.

Carbon, Nitrogen and Phosphorus Assimilation

Parameter Code Definitions

ALPHPIP1	Quantum yield (alpha) Pvl incubation (GF/F filtered) mg C/($\mu\text{E}/\text{m}^2/\text{s}$)/mg chl/hour
BETAPIP1	Photoinhibition coefficient (beta) Pvl incubation (GF/F filtered) mg C/($\mu\text{E}/\text{m}^2/\text{s}$)/mg chl/hour
NAUEROP1	Normalised ammonium uptake standard error (simulated in-situ conditions) Tracer-doped incubation in simulated in-situ light levels (GF/F filtered) Nanomoles per litre per hour
NAUPRBP1	Normalised ammonium uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$) Tracer-doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$ (GF/F filtered) Nanomoles per litre per hour
NAUPRDP1	Normalised ammonium uptake (dark) Tracer-doped incubation in darkness (GF/F filtered) Nanomoles per litre per hour
NAUPROP1	Normalised ammonium uptake (simulated in-situ conditions) Tracer-doped incubation in simulated in-situ light levels (GF/F filtered) Nanomoles per litre per hour
NCUEROP6	Normalised carbon uptake standard error (on-deck incubation) Radiotracer doped then incubated at simulated in-situ light level (sum size fractions >GF/F) Milligrams/metre cube/hour
NCUPRBP1	Normalised carbon uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$) Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$ (GF/F filtered) Milligrams/metre cube/hour
NCUPRBP4	Normalised carbon uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$) Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$ (sum size fractions >0.2 microns) Milligrams/metre cube/hour

- NCUPRCP1 Normalised carbon uptake ($80 \mu\text{E}/\text{m}^2/\text{s}$)
 Radiotracer doped constant light incubation at $80 \mu\text{E}/\text{m}^2/\text{s}$
 (GF/F filtered)
 Milligrams/metre cube/hour
- NCUPRDP1 Normalised carbon uptake (dark)
 Radiotracer doped incubation in the dark (GF/F filtered)
 Milligrams/metre cube/hour
- NCUPRDP4 Normalised carbon uptake (dark)
 Radiotracer doped incubation in the dark (sum size fractions
 >0.2 microns)
 Milligrams/metre cube/hour
- NCUPREP1 Normalised carbon uptake ($530 \mu\text{E}/\text{m}^2/\text{s}$)
 Radiotracer doped constant light incubation at $530 \mu\text{E}/\text{m}^2/\text{s}$
 (GF/F filtered)
 Milligrams/metre cube/hour
- NCUPROP6 Normalised carbon uptake (on-deck incubation)
 Radiotracer doped then incubated under simulated in-situ
 conditions (sum of size fractions $>\text{GF}/\text{F}$)
 Milligrams/metre cube/hour
- NCUPRZP4 Normalised carbon uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$ with antibiotic)
 Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$ with
 antibiotic (sum size fractions >0.2 microns)
 Milligrams/metre cube/hour
- NNUEROP1 Normalised nitrate uptake standard error (on-deck incubation)
 Tracer doped then incubated under simulated in-situ conditions
 (GF/F filtered)
 Nanomoles per litre per hour
- NNUPRBP1 Normalised nitrate uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$)
 Tracer-doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$ (GF/F
 filtered)
 Nanomoles per litre per hour
- NNUPRDP1 Normalised nitrate uptake (dark)
 Tracer-doped incubation in darkness (GF/F filtered)
 Nanomoles per litre per hour
- NNUPROP1 Normalised nitrate uptake (on-deck incubation)
 Tracer doped then incubated under simulated in-situ conditions
 (GF/F filtered)
 Nanomoles per litre per hour

- NPUPRBP4 Normalised phosphorus uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$)
 Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$
 (sum size fractions >0.2 microns)
 Nanomoles per litre per hour
- NPUPRCP4 Normalised phosphorus uptake ($80 \mu\text{E}/\text{m}^2/\text{s}$)
 Radiotracer doped constant light incubation at $80 \mu\text{E}/\text{m}^2/\text{s}$
 (sum size fractions >0.2 microns)
 Nanomoles per litre per hour
- NPUPRDP4 Normalised phosphorus uptake (dark)
 Radiotracer doped incubation in the dark (sum size fractions
 >0.2 microns)
 Nanomoles per litre per hour
- NPUPREP4 Normalised phosphorus uptake ($530 \mu\text{E}/\text{m}^2/\text{s}$)
 Radiotracer doped constant light incubation at $530 \mu\text{E}/\text{m}^2/\text{s}$
 (sum size fractions >0.2 microns)
 Nanomoles per litre per hour
- NPUPRFP4 Normalised phosphorus uptake (with DCMU photosynthesis
 inhibitor)
 Radiotracer doped incubation with DCMU (sum size fractions
 >0.2 microns)
 Nanomoles per litre per hour
- NPUPRPP4 Normalised phosphorus uptake (azide control)
 Radiotracer doped azide poisoned control incubation (sum size
 fractions >0.2 microns)
 Nanomoles per litre per hour
- NPUPRYP4 Normalised phosphorus uptake (dark with antibiotic)
 Radiotracer doped incubation in the dark with antibiotic (sum
 size fractions >0.2 microns)
 Nanomoles per litre per hour
- NPUPRZP4 Normalised phosphorus uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$ with antibiotic)
 Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$
 (sum size fractions >0.2 microns)
 Nanomoles per litre per hour
- NUUPRBP1 Normalised urea uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$)
 Tracer-doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$ (GF/F
 filtered)
 Nanomoles per litre per hour
- PMAPIP1 Photosynthetic maximum (P_{max})
 Pvl incubation (GF/F filtered)
 mg C/mg chl/hour

SEALPIP1 Quantum yield (alpha) standard error
Pvl incubation (GF/F filtered)
mg C/($\mu\text{E}/\text{m}^2/\text{s}$)/mg chl/hour

SEPXPIP1 Photosynthetic maximum (Pmax) standard error
Pvl incubation (GF/F filtered)
mg C/mg chl/hour

SNCEROPA Size-fractionated normalised carbon uptake standard error
(on-deck incubation)
Radiotracer doped incubation at simulated in-situ conditions (>5
micron size fraction)
Milligrams/metre cube/hour

SNCEROPC Size-fractionated normalised carbon uptake standard error
(on-deck incubation)
Radiotracer doped incubation at simulated in-situ conditions (2-5
micron size fraction)
Milligrams/metre cube/hour

SNCEROPN Size-fractionated normalised carbon uptake standard error
(on-deck incubation)
Radiotracer doped incubation at simulated in-situ conditions
(GF/F-2 micron size fraction)
Milligrams/metre cube/hour

SNCURBPB Size-fractionated normalised carbon uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$)
Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$
(>2 μm size fraction)
Milligrams/metre cube/hour

SNCURBPF Size-fractionated normalised carbon uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$)
Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$
(0.2-2 μm size fraction)
Milligrams/metre cube/hour

SNCURBPG Size-fractionated normalised carbon uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$)
Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$
(2-20 μm size fraction)
Milligrams/metre cube/hour

SNCURBPQ Size-fractionated normalised carbon uptake ($188 \mu\text{E}/\text{m}^2/\text{s}$)
Radiotracer doped constant light incubation at $188 \mu\text{E}/\text{m}^2/\text{s}$
(>20 μm size fraction)
Milligrams/metre cube/hour

SNCURDPB Size-fractionated normalised carbon uptake (dark)
Radiotracer doped incubation in the dark (>2 μm size fraction)
Milligrams/metre cube/hour

- SNCURDPF Size-fractionated normalised carbon uptake (dark)
Radiotracer doped incubation in the dark (0.2-2 μ m size fraction)
Milligrams/metre cube/hour
- SNCUROP A Size-fractionated normalised carbon uptake (on-deck incubation)
Radiotracer doped incubation at simulated in-situ conditions (>5 micron size fraction)
Milligrams/metre cube/hour
- SNCUROP C Size-fractionated normalised carbon uptake (on-deck incubation)
Radiotracer doped incubation at simulated in-situ conditions (2-5 micron size fraction)
Milligrams/metre cube/hour
- SNCUROP N Size-fractionated normalised carbon uptake (on-deck incubation)
Radiotracer doped incubation at simulated in-situ conditions (GF/F-2 micron size fraction)
Milligrams/metre cube/hour
- SNCURZPB Size-fractionated normalised carbon uptake (188 μ E/m²/s with antibiotic)
Radiotracer doped incubation at 188 μ E/m²/s with antibiotic (>2 μ m size fraction)
Milligrams/metre cube/hour
- SNCURZPF Size-fractionated normalised carbon uptake (188 μ E/m²/s with antibiotic)
Radiotracer doped incubation at 188 μ E/m²/s with antibiotic (0.2-2 μ m size fraction)
Milligrams/metre cube/hour
- SNPURBPB Size-fractionated normalised phosphorus uptake (188 μ E/m²/s)
Radiotracer doped constant light incubation at 188 μ E/m²/s (>2 μ m size fraction)
Nanomoles per litre per hour
- SNPURBPF Size-fractionated normalised phosphorus uptake (188 μ E/m²/s)
Radiotracer doped constant light incubation at 188 μ E/m²/s (0.2-2 μ m size fraction)
Nanomoles per litre per hour
- SNPURCPB Size-fractionated normalised phosphorus uptake (80 μ E/m²/s)
Radiotracer doped constant light incubation at 80 μ E/m²/s (>2 μ m size fraction)
Nanomoles per litre per hour

- SNCURCPF Size-fractionated normalised phosphorus uptake ($80 \mu\text{E}/\text{m}^2/\text{s}$)
Radiotracer doped constant light incubation at $80 \mu\text{E}/\text{m}^2/\text{s}$
(0.2-2 μm size fraction)
Nanomoles per litre per hour
- SNPURDPB Size-fractionated normalised phosphorus uptake (dark)
Radiotracer doped incubation in the dark (>2 μm size fraction)
Nanomoles per litre per hour
- SNPURDPF Size-fractionated normalised phosphorus uptake (dark)
Radiotracer doped incubation in the dark (0.2-2 μm size fraction)
Nanomoles per litre per hour
- SNPUREPB Size-fractionated normalised phosphorus uptake ($530 \mu\text{E}/\text{m}^2/\text{s}$)
Radiotracer doped constant light incubation at $530 \mu\text{E}/\text{m}^2/\text{s}$
(>2 μm size fraction)
Nanomoles per litre per hour
- SNPUREPF Size-fractionated normalised phosphorus uptake ($530 \mu\text{E}/\text{m}^2/\text{s}$)
Radiotracer doped constant light incubation at $530 \mu\text{E}/\text{m}^2/\text{s}$
(0.2-2 μm size fraction)
Nanomoles per litre per hour
- SNPURFPB Size-fractionated normalised phosphorus uptake (with DCMU
photosynthesis inhibitor)
Radiotracer doped incubation with DCMU (>2 μm size fraction)
Nanomoles per litre per hour
- SNPURFPF Size-fractionated normalised phosphorus uptake (with DCMU
photosynthesis inhibitor)
Radiotracer doped incubation with DCMU (0.2-2 μm size fraction)
Nanomoles per litre per hour
- SNPURPPB Size-fractionated normalised phosphorus uptake (azide control)
Radiotracer doped azide poisoned control incubation (>2 μm
size fraction)
Nanomoles per litre per hour
- SNPURPPF Size-fractionated normalised phosphorus uptake (azide control)
Radiotracer doped azide poisoned control incubation (0.2-2 μm
size fraction)
Nanomoles per litre per hour
- SNPURYPB Size-fractionated normalised phosphorus uptake (dark with
antibiotic)
Radiotracer doped incubation in the dark with antibiotic (>2 μm
size fraction)
Nanomoles per litre per hour

SNPURYPF	Size-fractionated normalised phosphorus uptake (dark with antibiotic) Radiotracer doped incubation in the dark with antibiotic (0.2-2µm size fraction) Nanomoles per litre per hour
SNPURZPB	Size-fractionated normalised phosphorus uptake (188 µE/m ² /s with antibiotic) Radiotracer doped incubation at 188 µE/m ² /s with antibiotic (>2µm size fraction) Nanomoles per litre per hour
SNPURZPF	Size-fractionated normalised phosphorus uptake (188 µE/m ² /s with antibiotic) Radiotracer doped incubation at 188 µE/m ² /s with antibiotic (0.2-2µm size fraction) Nanomoles per litre per hour

Originator Code Definitions

Belgica cruise BG9714C

10	Ir. Marc Elskens	VUB, Brussels, Belgium
14	Dr. Lei Chou	ULB, Brussels, Belgium
72	Prof. Roland Wollast	ULB, Brussels, Belgium
163	Dr. F. G. Figueiras	IIM, Vigo, Spain

Belgica cruises BG9815C, BG9919B and BG9919C

10	Ir. Marc Elskens	VUB, Brussels, Belgium
14	Dr. Lei Chou	ULB, Brussels, Belgium
72	Prof. Roland Wollast	ULB, Brussels, Belgium

Belgica cruises BG9714D, BG9815D, BG9919A

14	Dr. Lei Chou	ULB, Brussels, Belgium
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Charles Darwin cruises CD110B and CD114A

163	Dr. F. G. Figueiras	IIM, Vigo, Spain
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Charles Darwin cruise CD105B and Poseidon cruise PS237_1

3	Dr. Ian Joint	Plymouth Marine Laboratory, UK
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Professor Shtokman cruise ST0898 and Thalassa cruise TH1099

173	Pr. Emilio Fernández	University of Vigo, Spain
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Originator Protocols

Ir. Marc Elskens

Labelled nitrate, urea and ammonia (99% ^{15}N) were added to seawater samples in 2000 or 700 ml polycarbonate bottles. Tracer additions were kept as low as possible whilst still facilitating accurate measurements. Ambient levels were increased by 0.1 and 0.05 μM for nitrate and ammonia respectively.

Incubation conditions were 10-20 hours in constant light of 188 $\mu\text{E}/\text{m}^2/\text{s}$. Incubator temperature was controlled by continuously flushing with surface seawater.

At the end of the incubation the samples were filtered (Whatman GF/F) and converted to nitrogen gas by a modified Dumas method. Isotope detection was carried out by emission spectrometry (Fiedler and Proksh, 1975) using either a Jasco NIA-1 or N-151 analyser. High-purity tank nitrogen gas was used as a working standard during sample analysis.

Dr. Lei Chou

Water samples were collected using water bottles deployed on a CTD rosette. 200 ml aliquots were doped with 11.9 μCi ^{14}C and 20 μCi ^{32}P (as carrier-free $\text{H}_3^{32}\text{PO}_4$). The spiked samples were then incubated for between 6 and 20 hours under one or more of the following conditions:

- Constant light (80, 188 and 530 $\mu\text{E}/\text{m}^2/\text{s}$)
- Total darkness
- Azide poisoned
- Constant light (188 $\mu\text{E}/\text{m}^2/\text{s}$) with antibiotic (10% polymyxin B sulphate, 10% streptomycin sulphate: 100 μl per 200ml sample)
- Total darkness with above antibiotic
- Constant light (188 $\mu\text{E}/\text{m}^2/\text{s}$) with 3-(3,4-dichloro-phenyl)-1,1-dimethyl-urea photosynthetic activity inhibitor (DCMU).

Note that a number of samples were incubated in constant light with bottles sandwiched between neutral density filters to give a light gradient. These data have not been parameterised into P_{max} and α . Consequently, they cannot be mapped into the BOTDATA structure and the data may be found with the other non-parameterised production profiles elsewhere in the database (tables P33HDR and P33DAT).

Menten-Michaelis kinetics experiments were carried out by doping a series of bottles with a range of phosphate concentrations up to 1 μM and then incubating them at 188 $\mu\text{E}/\text{m}^2/\text{s}$. These data could not be loaded into BOTDATA without the concentration levels being mistaken for ambient phosphate concentrations. Consequently, a separate structure (tables

PUPVPO4 and PUPVPO4_LINK) was set up in the database to accommodate these data.

Temperature of incubation was controlled by a bath of pumped surface seawater. The incubation conditions for any data point may be determined from the parameter code.

At the end of the incubation the samples were filtered using a 2 micron and 0.2 micron Nuclepore filter cascade to obtain size-fractionated data.

Uptake rates were computed on the basis of the following ambient concentrations:

BG9714

Station	Depth m	PO ₄ μM	TCO ₂ mM/kg
8	10	0.021	2.023
12	10	0.014	2.048
19	10	0.046	2.036
19	60	0.477	2.122
25	10	0.067	2.023
25	60	0.083	2.089
29	10	0.011	2.041
29	60	0.062	2.084
37	10	0.274	2.083
37	60	0.420	2.110
40	10	0.039	2.034
40	60	0.128	2.086
42	10	0.028	2.044
42	60	0.063	2.074
47	10	0.044	2.057

BG9815

Station	Depth m	Expt.	PO ₄ used μM	TCO ₂ used mM/kg
2	10	All	0.019	2.344
2	60	CL	0.150	2.354
2	60	ANCL	0.157	2.354
2	60	D	0.175	2.354
2	60	AZ	0.175	2.354
2	60	DCMU	0.144	2.354
4	10	All	0.015	2.346
4	35	CL	0.064	2.356
4	35	ANCL	0.108	2.356
4	35	D	0.090	2.356
4	35	AND	0.110	2.356

Station	Depth m	Expt.	PO ₄ used μM	TCO ₂ used mM/kg
4	35	AZ	0.096	2.356
20	10	CL	0.062	2.336
20	10	ANCL	0.072	2.336
20	10	D	0.078	2.336
20	10	AND	0.078	2.336
20	10	AZ	0.089	2.336
20	10	DCMU	0.072	2.336
20	10	CL 80μE	0.062	2.336
20	40	CL	0.284	2.354
20	40	ANCL	0.267	2.354
20	40	D	0.274	2.354
20	40	AND	0.267	2.354
20	40	AZ	0.260	2.354
20	40	DCMU	0.276	2.354
20	40	CL 80μE	0.274	2.354
20	40	CL 530 μE	0.274	2.354
23	10	CL	0.010	2.342
23	10	ANCL	0.014	2.342
23	10	D	0.010	2.342
23	10	AND	0.029	2.342
23	10	AZ	0.013	2.342
23	10	DCMU	0.010	2.342
23	10	CL 80μE	0.010	2.342
23	10	CL 530 μE	0.010	2.342
23	60	CL	0.009	2.350
23	60	ANCL	0.021	2.350
23	60	D	0.009	2.350
23	60	AND	0.029	2.350
23	60	AZ	0.014	2.350
23	60	DCMU	0.009	2.350
23	60	CL 80μE	0.009	2.350
23	60	CL 530 μE	0.009	2.350
26	10	CL	0.013	2.345
26	10	ANCL	0.022	2.345
26	10	D	0.013	2.345
26	10	AND	0.026	2.345
26	10	AZ	0.013	2.345
26	10	CL 80μE	0.015	2.345
26	10	CL 530 μE	0.013	2.345
26	60	CL	0.155	2.347
26	60	ANCL	0.162	2.347
26	60	D	0.165	2.347
26	60	AND	0.176	2.347
26	60	AZ	0.164	2.347
26	60	CL 80μE	0.144	2.347
26	60	CL 530 μE	0.153	2.347

Station	Depth m	Expt.	PO ₄ used μM	TCO ₂ used mM/kg
33	10	CL	0.173	2.339
33	10	ANCL	0.178	2.339
33	10	D	0.182	2.339
33	10	AND	0.187	2.339
33	10	AZ	0.189	2.339
33	10	DCMU	0.179	2.339
33	10	CL 80μE	0.177	2.339
33	10	CL 530 μE	0.171	2.339
33	40	CL	0.362	2.339
33	40	ANCL	0.346	2.339
33	40	D	0.364	2.339
33	40	AND	0.350	2.339
33	40	AZ	0.371	2.339
33	40	DCMU	0.353	2.339
33	40	CL 80μE	0.373	2.339
33	40	CL 530 μE	0.357	2.339
33 bis	10	CL	0.408	2.339
33 bis	10	ANCL	0.402	2.339
33 bis	10	D	0.410	2.339
33 bis	10	AND	0.412	2.339
33 bis	10	AZ	0.430	2.339
33 bis	10	DCMU	0.283	2.339
33 bis	10	CL 80μE	0.413	2.339
33 bis	10	CL 530 μE	0.385	2.339
33 bis	40	CL	0.473	2.344
33 bis	40	ANCL	0.455	2.344
33 bis	40	D	0.465	2.344
33 bis	40	AND	0.448	2.344
33 bis	40	AZ	0.486	2.344
33 bis	40	DCMU	0.279	2.344
33 bis	40	CL 80μE	0.474	2.344
33 bis	40	CL 530 μE	0.444	2.344
35	10	CL	0.021	2.342
35	10	ANCL	0.043	2.342
35	10	D	0.023	2.342
35	10	AND	0.046	2.342
35	10	AZ	0.039	2.342
35	10	CL 80μE	0.030	2.342
35	10	CL 530 μE	0.030	2.342
35	60	CL	0.271	2.345
35	60	ANCL	0.278	2.345
35	60	D	0.273	2.345
35	60	AND	0.282	2.345
35	60	AZ	0.280	2.345
35	60	CL 80μE	0.289	2.345
35	60	CL 530 μE	0.255	2.345

Station	Depth m	Expt.	PO ₄ used μM	TCO ₂ used mM/kg
38	10	CL	0.011	2.354
38	10	ANCL	0.014	2.354
38	10	D	0.009	2.354
38	10	AND	0.014	2.354
38	10	AZ	0.011	2.354
38	10	CL 80μE	0.077	2.354
38	10	CL 530 μE	0.007	2.354
38	60	CL	0.123	2.352
38	60	ANCL	0.125	2.352
38	60	D	0.116	2.352
38	60	AND	0.136	2.352
38	60	AZ	0.141	2.352
38	60	CL 80μE	0.136	2.352
38	60	CL 530 μE	0.136	2.352
43	10	CL	0.033	2.341
43	10	ANCL	0.054	2.341
43	10	D	0.035	2.341
43	10	AND	0.055	2.341
43	10	AZ	0.046	2.341
43	10	DCMU	0.041	2.341
43	10	CL 80μE	0.037	2.341
43	10	CL 530 μE	0.030	2.341
43	60	CL	0.401	2.341
43	60	ANCL	0.393	2.341
43	60	D	0.409	2.341
43	60	AND	0.393	2.341
43	60	AZ	0.405	2.341
43	60	DCMU	0.398	2.341
43	60	CL 80μE	0.402	2.341
43	60	CL 530 μE	0.388	2.341

BG9919

Station	Depth m	TCO ₂ mM/kg	Station	Depth m	TCO ₂ mM/kg
5	5	2.038	33	5	2.038
5	40	2.079	33	20	2.047
11	5	2.003	37	5	2.044
11	40	2.133	37	40	2.049
12	5	2.050	44	5	2.056
12	30	2.115	44	30	2.115
14	5	2.043	44bis	5	2.087
14	50	2.062	44bis	20	2.118
29	5	2.041	45	5	2.063
29	30	2.136	45	45	2.132
30	5	2.033			
30	40	2.146			

Prof. Roland Wollast

Three types of experiment were carried out on water samples inoculated with ¹⁴C. Samples were incubated at constant light levels of 80, 188 and 530 $\mu\text{E}/\text{m}^2/\text{s}$ for 4 (BG9919), 6-8 (BG9815) or 6-9 (BG9714) hours. Temperature was controlled by continuously circulating surface seawater. Samples were GF/F filtered at the end of the incubation. At the end of the incubation the samples were filtered through GF/F filters and the retained activity determined. Data were supplied in units of $\mu\text{M}/\text{hour}$, which were converted to $\text{mg}/\text{m}^3/\text{hour}$ by multiplying by 12.

A second sample was incubated at 188 $\mu\text{E}/\text{m}^2/\text{s}$ and filtered through a cascade of 20, 2 and 0.2 micron pore filters. The relative activity of each filter was determined and delivered to BODC as percentages. These have been converted to absolute carbon uptake (to maintain compatibility with other size-fractionated data sets) using the appropriate GF/F carbon uptake from the experiments described above.

Photosynthesis versus irradiance experiments were performed in either 200 or 600 ml culture bottles in an artificial light gradient from 0 to 800 $\mu\text{E}/\text{m}^2/\text{s}$ in a bath maintained at constant temperature by circulating surface seawater. Incubation times were limited to 6-8 hours. The relationship between ¹⁴C uptake and light intensity has been parameterised following the model of Platt et al. (1980).

Derived integrated primary production data were also supplied and have been loaded into the table INTBOT.

Dr. F. G. Figueiras

Photosynthetic parameters were estimated using photosynthesis-irradiance (P-E) experiments. Samples were pipetted into 75 ml Corning tissue culture

flasks and inoculated with 1.85×10^5 Bq (5 μ Ci) $\text{NaH}^{14}\text{CO}_3$. They were incubated in a linear incubator, maintained at the sea temperature of the chlorophyll-a maximum using a Polyscience digital temperature controller. Osram tungsten-halogen lamps with a dichroic reflector and a Deco glass cover illuminated the incubator from the side. The irradiance in each cell was measured using a Li-Cor Li-109SA cosine sensor. The spectral irradiance at each location in the incubators was calculated from the relative mean spectrum of the tungsten-halogen lamps \times the corresponding photosynthetic available radiation at each point. The last bottle in the incubator was covered with aluminium foil as a dark control.

The samples were incubated for 2-3 hours, after which the suspended material was vacuum filtered through 25mm Whatman GF/F filters. The filters were fumed for 12 hours with HCl and then frozen. Disintegrations per minute (DPMs) were determined on return to the laboratory using a Packard Tri-Carb 2500 TR liquid scintillation analyzer using the external standard and the channel ratio methods to correct for quenching.

The P-E data were fitted to the model of Platt et al. (1980).

Derived integrated primary production data were also supplied and have been loaded into the table INTBOT.

Dr. Ian Joint

Replicate water samples were distributed into clear polycarbonate bottles and $^{15}\text{NO}_3$ and $^{15}\text{NH}_4$ were added. The concentrations of added isotope are shown with respect to the ambient concentrations in the following tables:

Charles Darwin cruise CD105B

Station	Depth (m)	$^{15}\text{NO}_3$ (μM)	NO_3 (μM)	$^{15}\text{NH}_4$ (μM)	NH_4 (μM)
N2000	10	0.006	0.07	0.006	<0.1
N2000	20	0.006	<0.05	0.006	<0.1
N2000	60	0.006	0.18	0.006	<0.1
O140	10	0.006	<0.05	0.125	<0.1
O140	20	0.006	<0.05	0.143	<0.1
O140	50	0.006	<0.05	0.125	<0.1
Q2500	10	0.021	<0.05	0.052	<0.1
Q2500	20	0.021	<0.05	0.052	<0.1
Q2500	60	0.021	0.33	0.052	<0.1
V2600	10	0.006	<0.05	0.083	<0.1
V2600	45	0.006	<0.05	0.083	<0.1
V2600	80	0.250	3.02	0.083	<0.1
U200	10	0.010	<0.05	0.063	<0.1
U200	35	0.010	0.25	0.063	<0.1
U200	60	0.375	4.05		<0.1
R1000	10	0.008	<0.05	0.008	<0.1
R1000	30	0.008	<0.05	0.008	<0.1

Station	Depth (m)	¹⁵ NO ₃ (μM)	NO ₃ (μM)	¹⁵ NH ₄ (μM)	NH ₄ (μM)
R1000	50	0.008	<0.05	0.008	<0.1
S600	10	0.008	<0.05	0.008	<0.1
S600	35	0.008	<0.05	0.008	<0.1
S600	60	0.025	0.150	0.033	<0.1
Q100	10	0.010	<0.05	0.008	<0.1
Q100	20			0.008	<0.1

Poseidon cruise PS237_1

All samples were taken from 10m depth

Station	¹⁵ NO ₃ (μM)	NO ₃ (μM)	¹⁵ NH ₄ (μM)	NH ₄ (μM)
P2270	0.008	0.52	0.013	0.14
P1650	0.100	0.01	0.013	0.28
P100	0.005	0.01	0.013	0.14
P186	0.005	0.07	0.011	0.19
S125	0.050	0.02	0.013	0.20
N200	0.005	0.44	0.013	0.11
P1470	0.005	0.22	0.013	0.25
S1060	0.020	0.07	0.013	0.18
S2750	0.005	0.01	0.013	0.27
P1460	0.005	0.38	0.013	0.15
Q535	0.020	0.83	0.013	0.14
P200	0.020	0.86	0.013	0.14

The samples were incubated at sea surface temperature for approximately 4 hours in an on-deck incubator at simulated in-situ light conditions or in darkness. The incubations were terminated by filtration (<40cm Hg vacuum) through pre-ashed Whatman GF/F filters. These were rinsed with filtered seawater, dried on board and stored over silica gel desiccant until analysed back at the laboratory.

Atomic percentage ¹⁵N was measured by continuous-flow nitrogen analysis mass spectrometry (Europa Scientific Ltd.) using the techniques described by Barrie et al. (1989) and Owens and Rees (1989). The rates of assimilation were calculated using the equations of Dugdale and Goering (1967).

The ambient nutrients on CD105B were measured using a conventional autoanalyser with relatively high detection limits, in oligotrophic conditions. Consequently, virtually every ambient value was below detection. This made computation of absolute nitrogen assimilation rates impossible. The problem was overcome by quoting the uptake rate in terms of a range that covered ambient nitrate ranging from 0.01 to 0.04μM and ambient ammonium ranging from 0.05 to 0.09μM. The data values stored in the database for this cruise are the mid-points of the quoted ranges and the standard errors are one half

of the range spans. If no standard error is present then the ambient nutrient value was above detection.

Prof. Emilio Fernández

Four 80ml aliquots (three replicates plus a dark control) of seawater, taken from the CTD rosette, were inoculated with 1295 KBq (35 μ Ci) of $\text{NaH}^{14}\text{CO}_3$. The samples were incubated in an on-deck incubator at light levels simulating the depth of sample collection. Incubations commenced at noon and lasted for four hours.

Incubation was terminated by filtration through a cascade of 5-micron and 2-micron pore filters plus a Millipore APFF glass fibre filter. The filters were fumed using concentrated HCl for 12 hours before being counted with 4ml of scintillation cocktail on an LKB beta-scintillation counter.

Notes on Data Quality

An intercalibration exercise involving PML, ULB, VUB and IIM was undertaken during July 1999. The overall conclusion from this was that the measurements were internally consistent.

Photosynthesis and Production Parameters

Parameter Code Definitions

- MFIXC1XX Maximum quantum yield of carbon fixation
Determined from Pmax and PAR absorption
Moles per Einstein
- PPABC1XX Phytoplankton PAR absorption
Estimated from phytoplankton spectral absorption coefficients
after Dubinsky (1980)
MicroEinsteins/cubic metre/second
- PPRDPICX Computed primary production
Computed from P:I data and PAR absorption
Milligrams/cubic metre/day
- SEMXC1XX Maximum quantum yield of carbon fixation error
Determined from Pmax and PAR absorption
Moles per Einstein

Originator Code Definitions

Belgica cruise BG9714C and Charles Darwin cruises CD110B and CD114A

163 Dr. F. G. Figueiras IIM, Vigo, Spain

Originator Protocols

Dr. F. G. Figueiras

The photosynthetic active radiation absorbed by phytoplankton was estimated according to the method of Dubinsky (1980).

The maximum quantum yield of carbon fixation was determined by fitting the photosynthetic rates to the photosynthetic radiation absorbed by phytoplankton.

The in situ primary production ($P_{Z(PUR)}$, mg C m⁻³ day⁻¹) was calculated as follows:

$$Pz_{(PUR)} = \int_{T=0}^{24} Chla.P_m^B \left[1 - \exp(-E_{PUR}(t)/E_{K(PUR)}) \right] dt$$

Where E_{PUR} is the photosynthetic active radiation absorbed by phytoplankton ($\mu\text{mol m}^{-3} \text{s}^{-1}$), P_m^B is the Chl-specific rate of photosynthesis ($\text{mg C mg Chl}^{-1} \text{h}^{-1}$) and $E_{K(PUR)}$ is the light saturation parameter of phytoplankton useable radiation ($\mu\text{mol m}^{-3} \text{s}^{-1}$).

Pigment Absorption Spectra

Parameter Code Definitions

PIGAnnnA Light absorption by pigments
Difference between spectrophotometric measurements on GF/F
filtered material before and after leaching by methanol
Per metre

nnn is the wavelength of the measurement in nanometres
Measurements range from 400nm to 700nm at a resolution of 1
nanometre (i.e. 301 parameters per sample).

Originator Code Definitions

Belgica cruise BG9714C and Charles Darwin cruises CD110B and CD114A

163 Dr. F. G. Figueiras IIM, Vigo, Spain

Originator Protocols

Dr. F. G. Figueiras

The light absorption coefficient of phytoplankton with the package effect was determined using a single beam, Beckman DU 650 spectrophotometer. Samples were filtered through glass fibre (GF/F) filters and the absorption at wavelengths of between 400 and 700 nm was measured on the filters. The light absorption by non-algal material was determined after extraction of pigments from the filter using absolute methanol. The light absorption coefficient was calculated from the absorption spectra minus the absorption of the non-algal material.

Pigments

Parameter Code Definitions

ABCRHPP1	Alpha-carotene plus beta-carotene HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
ALLOHPP1	Alloxanthin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
BCARHPP1	Beta-carotene HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
BUTAHPP1	Butanoyloxyfucoxanthin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
C1C2HPP1	Chlorophyll-c1c2 HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
CHLBHPP1	Chlorophyll-b HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
CLC3HPP1	Chlorophyll-c3 HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
CPHLFLP1	Fluorometric chlorophyll-a Fluorometric assay of acetone extract (GF/F filtered) Milligrams/cubic metre
CPHLFLP3	Fluorometric chlorophyll-a Fluorometric assay of acetone extract (GF/C filtered) Milligrams/cubic metre
CPHLFLP4	Fluorometric chlorophyll-a Fluorometric assay of acetone extraction (sum of size fractions >0.2 microns) Milligrams/cubic metre

CPHLFLP6	Fluorometric chlorophyll-a Fluorometric assay of acetone extraction (sum of size fractions >GF/F) Milligrams/cubic metre
CPHLHPP1	HPLC chlorophyll-a HPLC assay of acetone extract (GF/F filtered) Milligrams/cubic metre
CPHLPR01	CTD chlorophyll Calibrated in-situ fluorometer Milligrams/cubic metre
CPHLSSP6	Spectrophotometric chlorophyll-a (Jeffrey and Humphrey trichromatic) Spectrophotometric assay of acetone extraction (sum of size fractions >GF/F) Milligrams/cubic metre
CPHLYMP1	Fluorometric chlorophyll-a Yentsch+Menzel fluorometric assay on acetone extract (GF/F filtered) Milligrams/cubic metre
DIADHPP1	Diadinoxanthin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
DIATHPP1	Diatoxanthin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
DVCAHPP1	Diaviny chlorophyll-a HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
DVCBHPP1	Diaviny chlorophyll-b HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
FUCXHPP1	Fucoxanthin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
FVLTAQ01	Chelsea Instruments Aquatracka fluorometer output voltage Output voltage sampled by analogue to digital converter Volts

HEXOHPP1	Hexanoyloxyfucoxanthin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
LUTNHPP1	Lutein HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
PBAXHPP1	Phaeophorbide-a HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
PBBXHPP1	Phaeophorbide-b HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
PERIHPP1	Peridinin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
PHAEFLP1	Fluorometric phaeopigments Fluorometric assay of acetone extract (GF/F filtered) Milligrams/cubic metre
PHAEFLP3	Fluorometric phaeopigments Fluorometric assay of acetone extract (GF/C filtered) Milligrams/cubic metre
PTAXHPP1	Phaeophytin-a HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
PYPTHPP1	Pyropheophytin-a HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
SCHLFLPA	Size-fractionated fluorometric chlorophyll-a Fluorometric assay of acetone extract (>5 micron size fraction) Milligrams/cubic metre
SCHLFLPC	Size-fractionated fluorometric chlorophyll-a Fluorometric assay of acetone extract (2-5 micron size fraction) Milligrams/cubic metre
SCHLFLPF	Size-fractionated fluorometric chlorophyll-a Fluorometric assay of acetone extract (0.2-2 micron size fraction) Milligrams/cubic metre

SCHLSSPA	Size-fractionated fluorometric chlorophyll-a (Jeffrey and Humphrey trichromatic) Spectrophotometric assay of acetone extraction (>5 micron size fraction) Milligrams/cubic metre
SCHLSSPC	Size-fractionated fluorometric chlorophyll-a (Jeffrey and Humphrey trichromatic) Spectrophotometric assay of acetone extraction (2-5 micron size fraction) Milligrams/cubic metre
SCHLSSPN	Size-fractionated fluorometric chlorophyll-a (Jeffrey and Humphrey trichromatic) Spectrophotometric assay of acetone extraction (GF/F-2 micron size fraction) Milligrams/cubic metre
VILXHPP1	Violaxentin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre
ZEOXHPP1	Zeoxantin HPLC assay of acetone extract (GF/F filtered) Nanograms per litre

Originator Protocol Definitions

Belgica cruise BG9714B

14	Dr. Lei Chou	ULB, Brussels, Belgium
71	Dr. Stuart Gibb	Plymouth Marine Laboratory, UK
74	Ir. Andre Pollentier	BMM, Ostend, Belgium

Belgica cruise BG9714C

14	Dr. Lei Chou	ULB, Brussels, Belgium
74	Ir. Andre Pollentier	BMM, Ostend, Belgium
163	Dr. F. G. Figueiras	IIM, Vigo, Spain

Belgica cruise BG9714D

14	Dr. Lei Chou	ULB, Brussels, Belgium
74	Ir. Andre Pollentier	BMM, Ostend, Belgium

Belgica cruise BG9815B

69	Dr. Michel Frankignoulle	University of Liège, Belgium
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Belgica cruises BG9815C, BG9919B and BG9919C

14	Dr. Lei Chou	ULB, Brussels, Belgium
71	Dr. Stuart Gibb	Plymouth Marine Laboratory, UK
69	Dr. Michel Frankignoulle	University of Liège, Belgium
74	Ir. Andre Pollentier	BMM, Ostend, Belgium

Belgica cruises BG9815D, BG9919A

14	Dr. Lei Chou	ULB, Brussels, Belgium
69	Dr. Michel Frankignoulle	University of Liège, Belgium
74	Ir. Andre Pollentier	BMM, Ostend, Belgium

Belgica cruise BG9919D

69	Dr. Michel Frankignoulle	University of Liège, Belgium
74	Ir. Andre Pollentier	BMM, Ostend, Belgium

Charles Darwin cruise CD105B

3	Dr. Ian Joint	Plymouth Marine Laboratory, UK
16		British Oceanographic Data Centre
71	Dr. Stuart Gibb	Plymouth Marine Laboratory, UK

Charles Darwin cruise CD110A

16		British Oceanographic Data Centre
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Charles Darwin cruise CD110B

14	Dr. Lei Chou	ULB, Brussels, Belgium
16		British Oceanographic Data Centre
69	Dr. Michel Frankignoulle	University of Liège, Belgium
71	Dr. Stuart Gibb	Plymouth Marine Laboratory, UK
163	Dr. F. G. Figueiras	IIM, Vigo, Spain

Charles Darwin cruise CD114A

3	Dr. Ian Joint	Plymouth Marine Laboratory, UK
16		British Oceanographic Data Centre
69	Dr. Michel Frankignoulle	University of Liège, Belgium
71	Dr. Stuart Gibb	Plymouth Marine Laboratory, UK
137	Dr. Elaine Fileman	Plymouth Marine Laboratory, UK
163	Dr. F. G. Figueiras	IIM, Vigo, Spain

Charles Darwin cruise CD114B

3	Dr. Ian Joint	Plymouth Marine Laboratory, UK
16		British Oceanographic Data Centre
69	Dr. Michel Frankignoulle	University of Liège, Belgium
71	Dr. Stuart Gibb	Plymouth Marine Laboratory, UK
137	Dr. Elaine Fileman	Plymouth Marine Laboratory, UK

Poseidon cruise PS237_1

3	Dr. Ian Joint	Plymouth Marine Laboratory, UK
71	Dr. Stuart Gibb	Plymouth Marine Laboratory, UK
135	Dr. Rolf Peinert	Kiel University, Germany
137	Dr. Elaine Fileman	Plymouth Marine Laboratory, UK

Meteor cruise M43_2

69	Dr. Michel Frankignoulle	University of Liège, Belgium
96	Dr. Laurenz Thomsen	GEOMAR, Kiel, Germany

Professor Shtokman cruise ST0898 and Thalassa cruise TH1099

134	Dr. Antonio Bode	IEO, La Coruña, Spain
173	Pr. Emilio Fernández	University of Vigo, Spain

Pelagia cruise PLG108

76	Dr. Hendrik van Aken	NIOZ, Texel, the Netherlands
180	Dr. Marc Lavaleye	NIOZ, Texel, the Netherlands

Pelagia cruises PLG109 and PLG138

76	Dr. Hendrik van Aken	NIOZ, Texel, the Netherlands
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Pelagia cruise PLG121

96	Dr. Laurenz Thomsen	GEOMAR, Kiel, Germany
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Pelagia cruises PLG118 and PLG123

180	Dr. Marc Lavaleye	NIOZ, Texel, the Netherlands
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Originator Protocols

Dr. Lei Chou

Water samples were filtered through GF/F filters, which were placed in plastic vials and flash frozen in liquid nitrogen. Back in the laboratory, the pigments

were extracted into 90% acetone and the resulting extracts were assayed fluorometrically, following the protocols of Yentsch and Menzel (1963).

Dr. Stuart Gibb

Water samples were either collected from water bottles deployed on a CTD rosette or taken from a continuous surface seawater supply.

1-2 litres of water were filtered through a 25mm GF/F filter, flash frozen and stored in liquid nitrogen until analysed either on board or back in the laboratory.

Pigment concentrations were determined by reverse phase HPLC following the protocols described in Barlow et al. (1993a). Frozen filters were extracted in 90% acetone, sonicated and centrifuged to remove debris. An aliquot (300 µl) of clarified extract was mixed with an equal volume of 1M ammonium acetate and 100 µl of this mixture was injected into a Shimadzu HPLC system incorporating a 3 micron C18 Pecosphere column (3.3 x 0.45 cm, Perkin Elmer) heated to 30°C.

Pigments were separated by a linear binary gradient changing from 0% B to 100% B over 10 minutes, followed by an isocratic hold at 100% B for 7.5 minutes, at a flow rate of 1 ml per minute. Solvent A consisted of 80:20 (v/v) MeOH : ammonium acetate. Solvent B contained 60:40 (v/v) MeOH : acetone.

Chlorophylls and carotenoids were detected by absorbance at 440nm and phaeopigments by fluorescence detection at 405nm excitation, 670nm emission. Data collection and integration was performed with the Philips PU6000 chromatography software. Diavynyl chlorophyll-a was determined on some samples using a C8 column as described by Barlow et al. (1996).

Pigments were identified and calibrated by comparison with retention times of pigments isolated from well-documented microalgal species in the Plymouth Culture Collection and with standards obtained from the Water Quality Institute, Denmark. Peak identity was further confirmed on selected samples by on-line diode array visible spectroscopy. Chlorophyll-a and chlorophyll-b were calibrated using authentic standards (Sigma Chemical Co.) in acetone and quantified spectrophotometrically using the extinction coefficients of Jeffrey and Humphrey (1975). Diavynyl chlorophyll-a standard was obtained from R. Bidigare, University of Hawaii. Phaeopigment concentrations were estimated from peak areas and calibrations performed by simultaneous absorbance (667nm) and fluorescence detection of phaeopigments extracted from copepod and mussel faeces as detailed by Barlow et al. (1993b).

All pigments were supplied in units of ng/l. Chlorophyll-a values were converted to mg/m³ by dividing by 1000 to unify units for this parameter in the database.

Ir. André Pollentier

These samples were primarily collected for the calibration of the underway fluorometer. Consequently, except where samples were taken from CTD bottles for intercalibration purposes, the samples were taken from the non-toxic supply.

The water samples were filtered through GF/C filters. The filter papers were carefully folded, enclosed in aluminium foil capsules and placed in a chest freezer.

Back in the laboratory, the filters were extracted into 90% acetone and assayed fluorometrically.

Dr. F. G. Figueiras

Water samples were filtered through GF/F filters and frozen. Back in the laboratory, the pigments were extracted into 90% acetone and fluorometrically assayed following the protocols of Yentsch and Menzel (1963). Chlorophyll data were supplied both corrected (CPHLFL01) and uncorrected (CPHLYMP1) for phaeopigment.

Dr. Michel Frankignoulle

Water samples were filtered through GF/F filters and frozen. Back in the laboratory, the pigments were extracted into 90% acetone and fluorometrically assayed following the protocols of Yentsch and Menzel (1963). Chlorophyll data for some cruises were supplied both corrected (CPHLFL01) and uncorrected (CPHLYMP1) for phaeopigment.

Dr. Ian Joint

Size-fractionated chlorophyll-a was determined for each production station by filtering water samples through a cascade comprising 5, 2 and 0.2-micron pore filters. The filters were stored frozen until extracted into 90% acetone back at the laboratory. The extracts were assayed using a Turner Designs fluorometer.

British Oceanographic Data Centre

Calibrated fluorometer values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database. The fluorometer deployed on the CTD was always a Chelsea Instruments Aquatracka, which was calibrated by BODC against available extracted chlorophyll data.

The fluorometer calibrations are fully documented in the CTD data documentation and are summarised briefly below:

Charles Darwin cruise CD105B

The fluorometer was calibrated against HPLC chlorophyll (chlorophyll-a plus diaviny chlorophyll-a) giving quite a weak correlation ($R^2=41.8\%$).

Charles Darwin cruises CD110A and CD110B

The fluorometer was calibrated against HPLC chlorophyll (chlorophyll-a plus diaviny chlorophyll-a) giving a reasonable correlation ($R^2=60\%$). The calibration was derived from Leg B data, but has been applied to both legs of the cruise.

Charles Darwin cruises CD114A and CD114B

The fluorometer was calibrated against HPLC chlorophyll (chlorophyll-a: there were no diaviny chlorophyll-a data for these cruises) giving a good correlation ($R^2=76\%$ for leg A and 85% for leg B).

Dr. Elaine Fileman

Samples taken from the microzooplankton grazing experiments at time zero were filtered through GF/F filters, extracted into 90% acetone and assayed fluorometrically to give extracted chlorophyll.

Dr. Rolf Peinert

Calibrated fluorometer values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database.

The instrument used was a Chelsea Instruments Aquatracka fluorometer, which was calibrated at BODC. Initial attempts to calibrate the fluorometer using the HPLC data from this cruise were unsuccessful. The problem is believed to result from the high concentration of chlorophylls other than chlorophyll-a and degradation products. It may be possible to obtain a better calibration by including a wider range of HPLC pigments, but this has not been investigated. A second attempt, using the PML fluorometric data (summed size fractions) yielded much better results ($R^2=70.1\%$).

Prof. Emilio Fernández

Size-fractionated chlorophyll data were obtained by filtering 150 ml of sample through a cascade of 5-micron and 2-micron pore filters, followed by a Millipore APFF glass fibre filter. The pigments were cold-extracted into 90% acetone and assayed spectrophotometrically using a SAS FLX spectrophotometer, which had been calibrated using pure pigment extracts. The data were processed using the equations:

$$\begin{aligned} F(432/667) &= 2.53 C_a + 20.207 C_b + 18.329 C_c \\ F(463/652) &= 644.2 C_a + 3.546 C_b + 11.61 C_c \end{aligned}$$

$$F (451/633) = 1408.3 C_a + 58.47 C_b + 2.516 C_c$$

The data were reported as chlorophyll-a concentrations.

Dr. Antonio Bode

Size-fractionated chlorophyll-a data were obtained by filtering 150 ml of sample through a cascade of 5-micron and 2-micron pore filters, followed by a Millipore APFF glass fibre filter. The pigments were cold-extracted into 90% acetone and assayed on a Turner Designs fluorometer. The summed size fractions were submitted as a fluorometer calibration data set for ST0898.

A further, obviously different, chlorophyll data set was included with the IEO nitrogen regeneration data. These have been coded as GF/F filtrations that have been fluorometrically assayed.

Calibrated fluorometer values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database. For ST0898, the fluorometer was calibrated by applying the originator's calibration, which was based on fluorometric extracted chlorophyll data from the cruise. For TH1099, the fluorometer was calibrated by BODC using summed size-fraction data from University of Vigo. The result showed a very good correlation ($R^2=86.3\%$). Further details of the CTD fluorometer calibrations are included in the CTD data documentation.

Dr. Hendrik van Aken

Calibrated fluorometer values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database.

The fluorometer data were converted to chlorophyll using a nominal calibration built into the CTD processing software. A Chelsea Instruments Aquatracka fluorometer was used for cruises PLG108 and PLG109 and this seems to have produced sensible results. However, the data from the WET Labs AC3 instrument fitted for cruise PLG138 look highly suspect and should be used with caution.

Further details of the CTD fluorometer calibrations are included in the CTD data documentation.

Dr. Laurenz Thomsen

Water samples were collected using the BIOPROBE benthic water sampling lander (Thomsen et al., 1994). This was gently positioned on the seabed with approximately 20m of slack cable. A graduated rod, monitored by a video camera, determined penetration into the sediment, enabling precise sampling heights to be determined.

A timer switched on the sampling pumps after any sediment stirred up by the landing had dispersed. Sampling inlets were positioned at different heights on the instrument enabling water at different heights from the seabed to be collected. The samples were stored in a series of coiled plastic tubes, each of which had a capacity of 10 litres.

Water samples were filtered on GF/F filters, extracted into acetone and assayed fluorometrically using a Turner Designs fluorometer. Pigment concentrations were computed using the equations of Lorenzen (1967). Further details of the protocol are given in Thomsen and Graf (1995).

Dr. Marc Lavaleye

Water samples were taken from bottles on the BOLAS lander, filtered through GF/F filters and analysed by means of HPLC. The eluents, gradient and column were similar to those described in Wright et al. (1991) with minor modifications. Pigments were detected by a photodiode array coupled with a fluorometer and quantified according to Tahey et al. (1994).

Notes on Data Quality

The HPLC analyst reported that for BG9919 fucoxanthin may contain phaeophorbides and the chlorophyll-a data loaded were the sum of chlorophyll-a and chlorophyll-a allomer.

Bacterial Production, Abundance and Characteristics

Parameter Code Definitions

BPRDCVXX	Bacterial production expressed as carbon Computed from amino acid uptake, plus cell volume and abundance data Milligrams per cubic metre per day
GREFIEBC	Bacterial growth efficiency Incubation experiment on 0.8 micron filtered water Per cent
PRSPBLBC	Proportion of leucine respired (bacterial respiration) Bubbling technique to determine the proportion of labelled leucine respired Per cent
SDLERIP4	Standard deviation of leucine uptake rate Isotope doped, incubated, filtered (0.2 μm pore filter) and counted Picomoles/litre/hour
SDTHRIP4	Standard deviation of thymidine uptake rate Isotope doped, incubated, filtered (0.2 μm pore filter) and counted Picomoles/litre/hour
TBBMMApz	Total bacteria biomass as carbon Calculated from cell counts determined by epifluorescence microscopy with acridine orange stain Milligrams per cubic metre
TBBMMDPZ	Total bacteria biomass as carbon Calculated from cell counts determined by epifluorescence microscopy with DAPI stain Milligrams per cubic metre
TBCCMAPZ	Total bacteria cell numbers Microscopy (acridine orange stain) Number per millilitre
TBCCMDPZ	Total bacteria cell numbers Microscopy (DAPI stain) Number per millilitre

TBGZMAPA	Total bacteria cell number loss by grazing Incubation and dilution experiments Per cent per hour
TBMVIDPZ	Median volume of total bacteria Image analysis of DAPI stained sample Cubic microns
UPLERIP4	Leucine uptake rate Isotope doped, incubated, filtered (0.2 µm pore filter) and counted Picomoles/litre/hour
UPTHRIP4	Thymidine uptake rate Isotope doped, incubated, filtered (0.2 µm pore filter) and counted Picomoles/litre/hour

Originator Code Definitions

Meteor cruise M43_2 and Pelagia cruise PLG121

178 Dr. Karl-Paul Witzel Max-Planck Institute, Ploen, Germany

Charles Darwin cruise CD105B and Poseidon cruise PS237_1

3 Dr. Ian Joint Plymouth Marine Laboratory, UK

Almeida Carvalho cruise AC99, Belgica cruises BG9815C, BG9919B and BG9919C, Charles Darwin cruises CD110B, CD114A and CD114B and Professor Shtokman cruise ST0898

143 Dr. Helena Galvão UCTRA, University of the Algarve, Portugal

Originator Protocols

Dr. Karl-Paul Witzel

Water samples were collected using the CTD rosette or the BIOPROBE benthic water sampling lander (Thomsen et al., 1994). This collected 10-litre samples from up to four precisely defined depths in the bottom 50cm of the water column.

Bacterial cell numbers were determined by the DAPI direct counting technique. Cell numbers were supplied in units of 10^7 cells per litre (Pelagia) or 10^5 cells per millilitre (Meteor). These were converted to cells per millilitre

by multiplying by the appropriate power of 10. Bacteria cell volume was estimated using a Macintosh Power PC image analysis system according to the method of Thomsen (1991). A carbon conversion factor of 0.4 picograms of carbon per cubic micrometre was used to determine biomass from cell counts.

Bacterial production was measured by the incorporation of tritiated thymidine and leucine. Two versions of the leucine data were supplied, an uncorrected data set and a quench-corrected data set (uncorrected data multiplied by 2.06). The latter data set has been loaded into the database.

Carbon conversions were quoted from Simon and Azam (1989).

Dr. Ian Joint

Bacterial production was estimated from the rates of incorporation of [methyl-³H] thymidine and of L-[4,5-³H] leucine (specific activities 79 Ci/mmol and 171 Ci/mmol respectively; Amersham International plc, UK). Leucine stocks were routinely diluted 1:3 with unlabelled leucine. Stock radiotracer solutions were prepared using sterilised glassware and stored in pharmaceutical-grade serum bottles that had been pre-treated by filling with 0.25 molar Analar grade HCl, left to stand for three days, rinsed with Milli-Q water, filled with Milli-Q water and left to stand for a further two days. Serum bottles and their Teflon-lined silicone seals were autoclaved before use. Stock radiotracer solutions were prepared in sterile, 0.2 micron filtered, Milli-Q water and stored at 2°C. A fresh stock bottle was used for each experiment.

Tritiated thymidine incorporation experiments followed the methods of Fuhrman and Azam (1982) and the leucine incorporation experiments followed the methods of Simon and Azam (1989), modified to include the cold trichloroacetic acid (TCA) extraction method of Chin-Leo and Kirchman (1988). Five replicate, 10 ml aliquots from each depth sampled were transferred to sterile, polystyrene, tissue-culture tubes and placed in an incubator in the dark, at in-situ temperatures and allowed to acclimatise for 15 minutes prior to the addition of the isotope. Electron microscope grade glutaraldehyde was added to one replicate sample from each depth at a final concentration of 2.5% by volume to act as controls. ³H-thymidine or ³H-leucine was added to each tube to give final concentrations of 5 and 10 nM respectively.

The samples were incubated for one hour, but time-course assays showed that incorporation was linear for two hours and frequently longer.

At the end of the incubation, samples were transferred to an ice/water bath and ice-cold TCA added to give a final concentration of 5% by volume. The samples were left in the water bath for 15-30 minutes and filtered through 25mm 0.2 micron pore-size, track-etched, polycarbonate membrane filters. Each filter was rinsed five times with 1ml 5% ice-cold TCA, placed in a scintillation vial and stored in a desiccator with active silica gel for 24 hours. At the end of this period, the samples were counted in an LKB Rackbeta 1219

liquid scintillation counter. Counting efficiency was determined by an external standard, channels ratio method and checked by the occasional addition of internal standards.

Dr. Helena Galvão

Bacterial biomass was determined by filtering glutaraldehyde-fixed water samples through 0.2-micron polycarbonate filters and staining within acridine orange, according to Hobbie et al. (1977). This procedure was completed within 8 hours of sample collection. Bacterial abundance, mean cell size, frequency of dividing cells and biomass were determined by epifluorescence microscopy. This work was completed by spring 1999. Cellular carbon content was determined according to Simon and Azam (1989).

Bacterial production was measured by adding saturating concentrations of ^{14}C leucine to water samples and incubating for 2-6 hours in a water bath (modified from Kirchman et al. (1985)). Kinetic experiments were undertaken to ensure that the range of incubation durations used introduced no artefacts in the data. For ST0898, dark incubation was carried out at the temperature of the water column for 4 hours, which was blocked by the addition of formaldehyde. Within 48 hours, fixed incubated samples were filtered for scintillation counting (carried out at IIM or University of the Algarve). Leucine saturation curves were drawn for information on the local bacterial leucine uptake rates, where various quantities of ^{14}C -leucine were added to replicate samples and blanks, in order to establish the saturation concentration.

Incorporation of leucine may be converted to biomass production with the use of an empirically derived conversion factor. Two conversion factors were provided. The first was 3.1 kgC/mol leucine incorporated, according to Simon & Azam (1989), and the second was determined empirically during the ST0898 cruise, 0.44 kgC/mol leucine incorporated. The data are available in the database as amount of leucine incorporated, and the user is left to select the preferred conversion factor in order to calculate the bacterial production in terms of carbon.

Bacterial respiration was determined by measuring the recovery of $^{14}\text{CO}_2$ produced after addition of ^{14}C -leucine. The method involved purging samples after incubation, with 200 cm³ of air, in the presence of a minute volume of concentrated TCA (Tri-Chloroacetic Acid). The released $^{14}\text{CO}_2$ was captured in a trapping solution and analysed by scintillation counting. On Almeida Carvalho AC99, total microbial respiration and bacterial respiration (<0.8 µm) were determined using the Winkler technique to help interpret the fraction of respired leucine in total respiration.

Bacterial growth efficiency was determined from incubation experiments set up in large polycarbonate bottles containing diluted, 0.8 micron filtered (to remove grazers) seawater. Incubations lasted for approximately 36 hours, with samples taken every 6 hours for the determination of bacterial biomass. Growth efficiency was estimated as $100 \times (\text{carbon produced}) / (\text{carbon consumed})$. Further details may be found in Carlson and Ducklow (1996).

The level of grazing on bacteria was determined from parallel incubations in 2-litre polycarbonate bottles. Grazers were excluded from one experiment by 0.8-micron filtration. The water in the other experiment was screened through a 10-micron filter. Bacterial abundance was determined every 6 hours during the 36-hour incubation. Grazing rates were calculated as the difference between bacterial specific growth rate (<0.8 micron) and bacterial apparent growth rate (<10 micron) according to Wright and Coffin (1984). In addition, dilution experiments using the technique of Landry and Hassett (1982) with C, N and P additions were carried out on cruise AC99.

Suspended Particulate Material Concentration and Characterisation

Parameter Code Definitions

ABAGIXPZ	Aggregate abundance Particle camera image analysis Number per litre
ATTNZR01	Red light attenuation (unspecified beam) Unspecified path length transmissometer Per metre
ATTNZR02	Red light attenuation (unspecified beam) Unspecified path length transmissometer (second instrument) Per metre
ATTNZS01	Clear water corrected red-light attenuation (unspecified beam) WET Labs AC3 676 nm transmissometer calibrated to zero in clear water Per metre
MNGSIXAG	Mean grain size of SPM aggregates Image analysis Microns
MNGSPSXX	Mean grain size Particle sizer Microns
MOGSPSXX	Grain size mode Particle sizer Microns
MSAGIXPZ	Median aggregate size Particle camera image analysis Microns
NVLTAQ01	Aquatracka nephelometer output voltage In-situ Chelsea Instruments Aquatracka nephelometer Volts
NVLTST01	SeaTech nephelometer output In-situ SeaTech light backscatter sensor (LBSS) Volts

PC05PSXX	Grain size of the 5 th percentile Particle sizer Microns
PC50PSXX	Grain size of the 50 th percentile Particle sizer Microns
PC90PSXX	Grain size of the 90 th percentile Particle sizer Microns
POATCV01	Computed potential attenuation Computed using James Rennell Centre post-1999 algorithm Per metre
PRSCPSMO	Proportion of the sediment in the mode size class Particle sizer Per cent
PRSCPSSA	Proportion of the sediment in the >125 micron size class Particle sizer Per cent
PRSCPSSB	Proportion of the sediment in the 63-125 micron size class Particle sizer Per cent
PRSCPSSC	Proportion of the sediment in the 30-63 micron size class Particle sizer Per cent
PRSCPSSD	Proportion of the sediment in the 15-30 micron size class Particle sizer Per cent
PRSSPSSE	Proportion of the sediment in the <15 micron size class Particle sizer Per cent
SDGSIXAG	Arithmetic standard deviation of the SPM aggregate grain size Image analysis Microns
LDGSPSXX	Logarithmic standard deviation of the grain size distribution Particle sizer Dimensionless

SKGSPSXX	Skewness of the grain size distribution Particle sizer Dimensionless
TSEDGVP1	Total suspended particulate material (gravimetry) Gravimetric analysis (GF/F filtered) Milligrams per litre
TSEDGVP2	Total suspended particulate material (gravimetry) Gravimetric analysis (0.4/0.45 µm pore filtered) Milligrams per litre
TURBAQ01	Aquatracka turbidity In-situ Chelsea Instruments Aquatracka configured as a nephelometer and calibrated against formazin Standard turbidity units
TURBPR01	OBS turbidity In-situ optical backscatter nephelometer calibrated against formazin Standard turbidity units

Originator Code Definitions

Pelagia cruise PLG121

96	Dr. Laurenz Thomsen	GEOMAR, Kiel, Germany
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Meteor cruise M43_2

96	Dr. Laurenz Thomsen	GEOMAR, Kiel, Germany
16		British Oceanographic Data Centre

Almeida Carvalho cruises AC97 and AC99

91	Dr. Aurora Rodrigues	Instituto Hidrografico, Portugal
167	Dr. João Vitorino	Instituto Hidrografico, Portugal

Almeida Carvalho cruise CORVET

91	Dr. Aurora Rodrigues	Instituto Hidrografico, Portugal
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Charles Darwin cruise CD105B

15	Prof. Nick McCave	Cambridge University, UK
16		British Oceanographic Data Centre

Charles Darwin cruises CD110A, CD110B, CD114A and CD114B

16

British Oceanographic Data Centre

Pelagia cruises PLG109 and PLG138

75 Dr. Tjeerd van Weering

NIOZ, Texel, the Netherlands

76 Dr. Hendrik van Aken

NIOZ, Texel, the Netherlands

Pelagia cruises PLG108, PLG118, PLG123

76 Dr. Hendrik van Aken

NIOZ, Texel, the Netherlands

Poseidon cruise PS237_1

135 Dr. Rolf Peinert

Kiel University, Germany

Thalassa cruise TH1099

134 Dr. Antonio Bode

IEO, La Coruña, Spain

Belgica cruises BG9714B, BG9714C, BG9714D, BG9815C, BG9815D, BG9919A, BG9919B and BG9919C

74 Ir. Andre Pollentier

BMM, Ostend, Belgium

Originator Protocols

Prof. Nick McCave

Samples were collected in 10 l Niskin bottles mounted on the CTD rosette. 20 l of seawater were filtered under clean conditions, through pre-weighed (to 10^{-6} g) 0.4 μ m, 47 mm diameter polycarbonate membranes. The membranes were rinsed 5 times with 25 ml of Milli-Q water to remove salt. They were air-dried and stored in sealed polystyrene petri-dishes awaiting laboratory analysis. Handling was carried out within a Class-100 laminar flow hood.

Back at the laboratory the samples were further air dried and stored at a constant humidity until they were re-weighed to determine the SPM concentration. Weighing was done to 10^{-6} grams using a Mettler MT5 balance with a 125 μ Ci 241 Am alpha foil ionising source mounted in the balance for static reduction. All critical manipulations were carried out within a Class-100 laminar flow hood.

Data were supplied in units of μ g/l and converted to mg/l through division by 1000.

Dr. Tjeerd. van Weering

Samples were collected in 12 l NOEX bottles mounted on the CTD rosette. Between 1 and 3 bottles were filled in the BNL (bottom nepheloid layer), at 3m above the bottom, in the upper part of the BNL and in the INL (intermediate nepheloid layer).

On board, the bottles were shaken well before collecting the tapped water into 5-litre polyethylene bottles. The water was filtered through pre-weighed 0.45 µm polycarbonate filters under vacuum. Filters were rinsed with de-mineralised water to remove salt and flushed with alcohol (PLG109 only) to avoid contamination by organic growth. The filters were then stored in sealed petri-dishes awaiting laboratory analysis.

Dr. Laurenz Thomsen

Aggregate concentration and size

A particle camera was fitted to the BIOPROBE lander (Thomsen et al., 1994) mounted such that it was 40 cm above the sea floor when the instrument was on the bottom. Images were selected from the resulting video that represented periods when the lander was on the bottom and any disturbed sediment had cleared. The resulting images were analysed on a Macintosh Power PC image analysis system following the method of Thomsen and Ritzrau (1996) to obtain the aggregate abundance and size data.

Total particulate matter

Water samples were collected using the BIOPROBE benthic water sampling lander (Thomsen et al., 1994). This was gently positioned on the seabed with approximately 20m of slack cable. A graduated rod, monitored by a video camera, determined penetration into the sediment, enabling precise sampling heights to be determined.

A timer switched on the sampling pumps after any sediment stirred up by the landing had dispersed. Sampling inlets were positioned at different heights on the instrument enabling water at different heights from the seabed to be collected. The samples were stored in a series of coiled plastic tubes, each of which had a capacity of 10 litres.

Total suspended matter was determined gravimetrically by filtering through pre-weighed GF/F filters.

Dr. Aurora Rodrigues

Samples were collected from bottles deployed on the CTD rosette. Two aliquots were filtered through tared filters, a pre-ashed GF/F (subsequently used for POC analysis) and 0.45 micron pore filters. These were washed,

dried at 40°C and gravimetrically assayed to provide two independent estimates of the suspended particulate material concentration.

Sediment grain size parameters were derived from particle size spectra obtained using a particle sizer.

British Oceanographic Data Centre

The CTD package included a SeaTech light back-scatter sensor (LBSS) plus one or two (CD105 and CD110) SeaTech 20-cm 660nm path length transmissometers. The data as logged from the LBSS were included in the data set.

The transmissometer outputs were converted to optical attenuation, incorporating corrections for source decay based on laboratory and cruise air readings. Further details are included in the CTD data documentation, including details of calibration problems. The user is strongly recommended to consult this documentation.

Values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined and stored in the database.

Dr. João Vitorino

The CTD package included a Chelsea Instruments Aquatracka configured as a nephelometer on some casts. The raw output from this instrument was logged and included in the data set. Values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database.

Dr. Hendrik van Aken

The CTD package included a SeaTech 25-cm path length 665 nm monochromatic light source transmissometer on all cruises. An additional WET Labs AC3 system, measuring optical attenuation at 676 nm, was included on cruise PLG138. The SeaTech transmissometer was processed, including an air correction, to attenuation by the SeaBird software. Clear water values appeared slightly high (0.38-0.4: 0.35-0.36 expected at 660nm). The AC3 was calibrated to give attenuation due to suspended load. Consequently, the expected clear water value is zero.

Values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database.

Dr. Rolf Peinert

The Poseidon CTD package included a Chelsea Instruments Aquatracka configured as a nephelometer on some casts and a SeaTech 25-cm 660 nm transmissometer on others. The raw output from the Aquatracka was logged and included in the data set.

The transmissometer output was converted to attenuation and empirically calibrated by normalising clear water values to 0.36. Further details of this correction are given in the CTD data documentation.

Values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database.

Dr. Antonio Bode

The CTD package incorporated a transmissometer (type and path-length unknown). Attenuance was computed assuming a path length of 10 cm and an empirical correction of -0.025 applied to normalise the clear water data to 0.35. Further details of the processing rationale are given in the CTD data documentation.

Values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database.

Ir. André Pollentier

The Belgica CTD package incorporated a SeaBird optical backscatter sensor. This was logged and calibrated using SeaBird coefficients based on a laboratory formazin calibration. Values from the CTD **downcasts** at depths corresponding to the bottle firings have been determined by BODC and stored in the database.

Particulate Trace Metals

Parameter Code Definitions

ALCNAAP2	Particulate aluminium content Atomic absorption (0.45/0.4 µm pore filtered) Per Cent
ALCNAAPC	Particulate aluminium content Atomic absorption (centrifuged) Per Cent
CACNICP2	Particulate calcium content ICP after acid digestion (0.45/0.4 µm pore filtered) Per Cent
CACNICPC	Particulate calcium content ICP after acid digestion (centrifuged) Per Cent
CDCNAAP2	Particulate cadmium content Atomic absorption (0.45/0.4 µm pore filtered) Parts per million
CDCNAAPC	Particulate cadmium content Atomic absorption (centrifuged) Parts per million
COCNAAP2	Particulate cobalt content Atomic absorption (0.45/0.4 µm pore filtered) Parts per million
COCNAAPC	Particulate cobalt content Atomic absorption (centrifuged) Parts per million
CRCNAAP2	Particulate chromium content Atomic absorption (0.45/0.4 µm pore filtered) Parts per million
CRCNAAPC	Particulate chromium content Atomic absorption (centrifuged) Parts per million

CUCNAAP2 Particulate copper content
Atomic absorption (0.45/0.4 µm pore filtered)
Parts per million

CUCNAAPC Particulate copper content
Atomic absorption (centrifuged)
Parts per million

FECNAAP2 Particulate total iron content
Atomic absorption (0.45/0.4 µm pore filtered)
Per Cent

FECNAAPC Particulate total iron content
Atomic absorption (centrifuged)
Per Cent

KXCNICP2 Particulate potassium content
ICP after acid digestion (0.45/0.4 µm pore filtered)
Per Cent

KXCNICPC Particulate potassium content
ICP after acid digestion (centrifuged)
Per Cent

MGCNICP2 Particulate magnesium content
ICP after acid digestion (0.45/0.4 µm pore filtered)
Per Cent

MGCNICPC Particulate magnesium content
ICP after acid digestion (centrifuged)
Per Cent

MNCNAAP2 Particulate total manganese content
Atomic absorption (0.45/0.4 µm pore filtered)
Per Cent

MNCNAAPC Particulate total manganese content
Atomic absorption (centrifuged)
Per Cent

NACNICP2 Particulate sodium content
ICP after acid digestion (0.45/0.4 µm pore filtered)
Per Cent

NACNICPC Particulate sodium content
ICP after acid digestion (centrifuged)
Per Cent

NICNAAP2	Particulate nickel content Atomic absorption (0.45/0.4 µm pore filtered) Parts per million
NICNAAPC	Particulate nickel content Atomic absorption (centrifuged) Parts per million
PBCNAAP2	Particulate lead content Atomic absorption (0.45/0.4 µm pore filtered) Parts per million
PBCNAAPC	Particulate lead content Atomic absorption (centrifuged) Parts per million
SICNICP2	Particulate silicon content ICP after acid digestion (0.45/0.4 µm pore filtered) Per Cent
SICNICPC	Particulate silicon content ICP after acid digestion (centrifuged) Per Cent
ZNCNAAP2	Particulate zinc content Atomic absorption (0.45/0.4 µm pore filtered) Parts per million
ZNCNAAPC	Particulate zinc content Atomic absorption (centrifuged) Parts per million

Originator Code Definitions

Belgica cruises BG9714C, BG9714D, BG9815C, BG9815D, BG9919A, BG9919B, BG9919C and Charles Darwin cruise CD110B

14 Dr. Lei Chou ULB, Brussels, Belgium

Originator Protocols

Dr. Lei Chou

Samples were obtained using one of two protocols. The protocol used may be identified by the gear code in the EVENT entry for the data (SAP or GPCENT).

SAP collection

Challenger Oceanics in-situ stand-alone pumps (SAPs) were used to sample particulate material. The instruments were deployed on kevlar rope from an auxiliary winch and were switched on and off by a programmable timer to ensure that the pump only sampled when in position at the desired depth. Membrane filters with a 0.4 micron pore size were used to collect the particulate material.

On recovery the filters were rinsed and dried in clean conditions. Back at the home laboratory, the suspended particulate material was ultrasonically detached from the filter for analysis.

GPCENT collection

Suspended particulate matter was collected by continuous flow centrifugation using an Alpha-Laval oil purifier (model MAB 104) specially coated for oceanographic use. Water supply was adjusted to approximately 1 cubic metre per hour. Samples were collected both when the ship was on station and steaming between stations for about 6-10 hours.

Samples were taken from the centrifuge body using a stainless steel spatula, stored in acid-washed PET vials and immediately deep frozen. After weighing (wet weight) the sample was subdivided for C/N and trace metal analysis.

Analysis

The samples were analysed for Al, Cu, Fe, Mn, Cr, Ni, Co, Zn, Cd and Pb by direct injection of solid samples as slurries using electrothermal atomic absorption spectroscopy in a Varian Spectraa-300 spectrometer with Zeeman correction.

Major elements were determined by Inductively Coupled Plasma emission spectroscopy after complete digestion of the samples by an HNO₃/HCl/HF mixture in a Teflon bomb in a microwave oven.

If there was insufficient material for the direct injection technique, trace elements were also determined on the digested samples either by ICP, if present in sufficient concentration, or by AA. The parameter codes have been set up to indicate the predominant method for the element.

Methane and Nitrous Oxide

Parameter Code Definitions

CH4CGCXX	Dissolved methane Gas chromatography Nanomoles per litre
CH4SGCXX	Methane saturation Computed from methane concentration Per cent
DN2OGCTX	Dissolved nitrous oxide Gas chromatography on unfiltered water Nanomoles per litre
SN2OGCTX	Nitrous oxide saturation Computed from GC-measured concentration Per cent

Originator Code Definitions

Meteor cruise M43_2

73	Prof. Robin Keir	GEOMAR, Kiel, Germany
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Charles Darwin cruise CD114B

3	Dr. Ian Joint	Plymouth Marine Laboratory, UK
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Originator Protocols

Prof. Robin Keir

Water samples were collected from the CTD rosette and analysed on board ship for dissolved methane. The gas phase was obtained by two methods. The first involved a partial separation of gas and water phases under vacuum using repeated application of ultrasound. The second utilised equilibration of the water sample with a small volume of added pure nitrogen head space. Dissolved methane was then computed from the measured gas phase mixing ratio and the methane solubility at the laboratory conditions of temperature and salinity.

Dr. Ian Joint

Water samples were taken from the CTD rosette bottles by filling a single 100ml universal bottle, overfilled by three times its volume. 200µl of saturated mercuric chloride solution was added and the bottle was sealed and stored in the dark at room temperature prior to analysis by electron capture detector gas chromatography in the laboratory following a headspace equilibration technique.

The gas chromatographic analyses were made over 4 days in September 1998, so that samples were stored less than 30 days. Nitrous oxide concentration was calculated thus:

$$C_w = C_a' (V_h/V_w + a) - ((C_o \cdot V_h)/V_w)$$

Where:

C_w	= concentration in seawater
C_a'	= concentration in headspace after equilibration
V_h	= volume of headspace
V_w	= volume of seawater
a	= solubility coefficient at analysis temperature and salinity
C_o	= concentration in headspace before equilibration

Nitrous oxide saturation was computed assuming a constant atmospheric mixing ratio of 315 ppb.

Dissolved Oxygen

Parameter Code Definitions

DOXYPR01	Beckman oxygen Beckman oxygen probe Micromoles/litre
DOXYWITX	Winkler oxygen Winkler titration Micromoles/litre
OXYBB01	Oxygen saturation (Bens.Kr./Beckman) Benson & Krause algorithm from Beckman data Per cent
OXYBW01	Oxygen saturation (Bens.Kr./Winkler) Benson & Krause algorithm from Winkler titration data Per cent

Originator Code Definitions

Belgica cruises BG9714B, BG9714C, BG9714D, BG9815C, BG9815D, BG9919A, BG9919B and BG9919C

69	Dr. Michel Frankignoulle	University of Liège, Belgium
74	Ir. Andre Pollentier	MUMM, Ostend, Belgium

Belgica cruise BG9815B and Charles Darwin cruises CD110B, CD114A and CD114B

69	Dr. Michel Frankignoulle	University of Liège, Belgium
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Charles Darwin cruise CD105B

16	British Oceanographic Data Centre
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Pelagia cruises PLG108 and PLG138

11	Dr. Wim Helder	NIOZ, Texel, the Netherlands
76	Dr. Hendrik van Aken	NIOZ, Texel, the Netherlands

Pelagia cruises PLG109, PLG118 and PLG123

11	Dr. Wim Helder	NIOZ, Texel, the Netherlands
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Meteor cruise M43_2

16		British Oceanographic Data Centre
69	Dr. Michel Frankignoulle	University of Liège, Belgium

Professor Shtokman cruise ST0898

134	Dr. Antonio Bode	IEO, La Coruña, Spain
173	Pr. Emilio Fernández	University of Vigo, Spain

Thalassa cruise TH1099

134	Dr. Antonio Bode	IEO, La Coruña, Spain
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Originator Protocols

Dr Michel Frankignoulle

Water samples from CTD rosette bottles were analysed using the classical Winkler technique with minor modifications. Calibrated 100ml oxygen bottles with ground glass stoppers were thoroughly flushed then filled without trapping any air. 1 ml of solution A (600g $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ per litre) and 2ml of solution B (250g NaOH, 350g KI per litre) were added immediately and the closed bottles shaken vigorously. The samples were shaken again once the precipitate had settled. The samples were titrated using a Metrohm automatic titration system.

The data were supplied in units of micromoles/kg. These were converted to micromoles/litre through application of the following transform:

$$\text{Database value} = \text{Original value} / \text{TOKGxx01}$$

Where TOKGxx01 is the database litres to kilogram conversion factor TOKGPR01 or TOKGSG01 (PR = CTD, SG = thermosalinograph), which is stored with the data.

Oxygen saturations were computed using calibrated temperature and salinity data and the algorithm of Benson and Krause (1984).

Ir Andre Pollentier

The oxygen probe concentrations and saturations in table BOTDATA have been obtained by extracting the data from the CTD **downcasts** corresponding to the bottle firing depths. The CTD system used was a SeaBird SBE 9 or 9 *plus* with a YSI oxygen sensor. Oxygen data were calibrated against the University of Liège water bottle data.

Oxygen saturations were computed using calibrated temperature and salinity data and the algorithm of Benson and Krause (1984).

Dr. Wim Helder

Water samples from CTD rosette bottles were analysed using the classical Winkler technique with minor modifications. Calibrated 100ml oxygen bottles with ground glass stoppers were thoroughly flushed then filled without trapping any air. 1 ml of solution A (600g $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ per litre) and 2 ml of solution B (250g NaOH, 350g KI per litre) were added immediately and the closed bottles shaken vigorously. The samples were shaken again once the precipitate had settled. The bottles were stored under water with the stoppers held closed by elastic bands.

Prior to analysis, about 25 ml of the supernatant was removed by syringe and then 1 ml of 20N sulphuric acid was added. Titration was carried out with 0.01N sodium thiosulphate in a Brand Digital Burette.

When the solutions in the bottle turned light yellow, 0.5 ml of 1% starch solution was added and titration continued until the solution became colourless. The sodium thiosulphate solution was made from a 0.1N stock solution in ampoules (Merck) and its strength was regularly checked by titration with 0.01N KIO_3 . Blank corrections were applied. An automatic Metrohm titration unit with spectrophotometric end point detection was used for the titrations.

All samples were determined in duplicate at least. Accuracy is reported to be within 1%.

The data were supplied in units of micromoles/kg. These were converted to micromoles/litre through application of the following transform:

$$\text{Database value} = \text{Original value} / \text{TOKGPR01}$$

Where TOKGPR01 is the database litres to kilogram conversion factor computed from true in-situ density, which is stored with the data.

Dr. Hendrik van Aken

The oxygen probe concentrations and saturations in table BOTDATA have been obtained by extracting the data from the CTD **downcasts** corresponding to the bottle firing depths. The CTD system used was a SeaBird SBE 911 *plus* with oxygen sensor. Oxygen data were calibrated against the NIOZ water bottle data.

Oxygen saturations were computed using calibrated temperature and salinity data and the algorithm of Benson and Krause (1984).

British Oceanographic Data Centre

The oxygen probe concentrations and saturations in table BOTDATA have been obtained by extracting the data from the CTD **downcasts** corresponding

to the bottle firing depths. The CTD system used was a Neil Brown Mk3B with a non-pulsed membrane oxygen sensor.

The CTD oxygen for CD105B was calibrated against a single cast of bottle data from Belgica taken on a simultaneous intercalibration exercise. This is a fragile calibration strategy, but the results look reasonable. Further details are given in the CTD data documentation. The Meteor M43_2 data were calibrated against Liège bottle data.

Oxygen saturations were computed using calibrated temperature and salinity data and the algorithm of Benson and Krause (1984).

Dr. Antonio Bode

The oxygen probe concentrations and saturations in table BOTDATA have been obtained by extracting the data from the CTD **downcasts** corresponding to the bottle firing depths.

The CTD data for ST0898 were calibrated against the Vigo bottle data. However, the bottle data were only from shallow depths and there is concern over the calibrated data at depth, particularly the oxygen minimum. The CTD oxygens from TH1099 are **UNCALIBRATED**, but have been normalised against data from Belgica cruises. It is strongly recommended that the CTD data documentation is consulted and that the CTD oxygen from both of these cruises be used with **CAUTION**.

Oxygen saturations were computed using calibrated temperature and salinity data and the algorithm of Benson and Krause (1984).

Pr. Emilio Fernández

Water for dissolved oxygen determinations was collected to overflowing in individually calibrated borosilicate bottles. The Winkler reagents were added and the result was titrated using a Metrohm 716 DMS Titrino automated system, with a potentiometric end point.

Oxygen Production and Total Community Respiration

Parameter Code Definitions

GOXPLDPX	Gross oxygen production Light/dark bottle incubation Micromoles/litre/day
NOXPLDPX	Net oxygen production Light/dark bottle incubation Micromoles/litre/day
RESPLDPX	Respiration Light/dark bottle incubation Micromoles/litre/day
SEGPLDPX	Gross oxygen production standard error Light/dark bottle incubation Micromoles/litre/day
SENPLDPX	Net oxygen production standard error Light/dark bottle incubation Micromoles/litre/day
SERPLDPX	Respiration standard error Light/dark bottle incubation Micromoles/litre/day

Originator Code Definitions

Professor Shtokman cruise ST0898 and Thalassa cruise TH1099

173 Pr. Emilio Fernández University of Vigo, Spain

Originator Protocols

Pr. Emilio Fernández

Twelve 125ml seawater samples were taken in pre-calibrated borosilicate bottles. Four were immediately analysed for dissolved oxygen. Four were incubated in the dark for 24 hours before dissolved oxygen was determined. The remaining four bottles were kept under a light-dark diel cycle in an on-deck incubator before dissolved oxygen was determined.

All dissolved oxygen measurements were made by automated precision Winkler titration performed with a Metrohm 716 DMS Titrino, using a potentiometric end point.

Hydrography

Parameter Code Definitions

POTMCV01	Potential temperature (UNESCO) Computed using UNESCO function POTEMP Degrees Centigrade
PSALBSTX	Bench salinometer salinity Salinometer Practical Salinity Units
PSALST01	Practical salinity (CTD) CTD conductivity measurement Practical Salinity Units
SIGTPR01	Sigma-theta (CTD data) Computed by UNESCO SVAN function Kilograms/cubic metre
TEMPRTNX	RT temperature Reversing thermometer Degrees centigrade
TEMPST01	Sea temperature (CTD/STD) CTD or STD measurement Degrees centigrade
TOKGPR01	μM to $\mu\text{moles/kg}$ conversion (CTD) CTD measurement Kilograms per litre
TOKGSG01	μM to $\mu\text{moles/kg}$ conversion (thermosalinograph) Thermosalinograph measurement Kilograms per litre

Originator Code Definitions

Belgica cruises BG9714B, BG9714C, BG9714D, BG9815B, BG9815C, BG9815D, BG9919A, BG9919B, BG9919C and BG9919D

Charles Darwin cruise CD105A

1 Research Vessel Services, UK

Charles Darwin cruises CD105B, CD110A, CD110B, CD114A and CD114B

1 Research Vessel Services, UK
16 British Oceanographic Data Centre

Meteor cruise M43 2

135 Dr. Rolf Peinert Kiel University, Germany
16 British Oceanographic Data Centre

Pelagia cruises PLG108, PLG109, PLG118, PLG123 and PLG138

76 Dr. Hendrik van Aken NIOZ, Texel, the Netherlands

Poseidon cruise PS237 1

135 Dr. Rolf Peinert Kiel University, Germany

Professor Shtokman cruise ST0898 and Thalassa cruise TH1099

134 Dr. Antonio Bode IEO, La Coruña, Spain

Almeida Carvalho cruises AC97 and AC99

167 Dr. João Vitorino Instituto Hidrografico, Portugal

Originator Protocols

NB: All Originators

In most cases where the parameter code ends in '01', the values have been obtained by BODC software that extracts CTD **downcast** data corresponding to the bottle firing depths. This ensures an internally consistent data set across all cruises regardless of whether or not the upcast data were made available. The method is prone to errors if significant changes occur to water column structure during the cast. In all cases, further details about the CTD data may be obtained from the CTD document for the relevant cruise.

The conversion factors TOKGPR01/TOKGSG01 are $1000/(1000+\sigma\text{-theta})$ and are stored to allow sample data stored in concentration per litre to be converted to concentration per kilogram.

Further details of calibrations, including comments on data quality, may be obtained from the CTD data documentation.

Ir. Andre Pollentier

CTD data were taken using a SeaBird SBE 9 *plus* CTD. The instrument is well maintained and frequently recalibrated.

Water samples are collected in cleaned beer bottles and sealed with crown corks. Back in the laboratory, salinity is determined using a Guildline Portasal bench salinometer. The bottle data were used to apply corrections to the CTD data. See the CTD data documentation for details.

Dr. Hendrik van Aken

Water samples from CTD rosette bottles were analysed on board ship using a Guildline model 8400 Autosol together with software developed at NIOZ. The instrument was calibrated against standard seawater.

CTD data were taken using a SeaBird SBE 911 *plus* CTD. The instrument was well maintained and frequently calibrated. Data were back calibrated against bottle salinities or known high quality deep T/S profiles at NIOZ.

Dr. Rolf Peinert

Bottle salinity data for Poseidon 237_1 and Meteor 43_2 were analysed at IfM Kiel by technicians working to WOCE standards. No dedicated salinity bottles were available for M43_2, but glass mineral water bottles with plastic caps proved an adequate substitute.

The CTD data were collected using a Neil Brown Mk V instrument on Poseidon. Temperatures have been assumed correct. Salinities have been back calibrated against bottle data.

British Oceanographic Data Centre

An RVS Neil Brown Mk 3B CTD was used on the Charles Darwin cruises. A SeaBird SBE9-11 *plus* CTD was used on Meteor. Temperatures on Meteor were assumed correct for the Meteor cruise, but have been checked (not calibrated) against calibrated SIS reversing thermometer data for the Darwin cruises. All salinities have been back calibrated against sample data determined by salinometer.

Research Vessel Services

Temperature measurements were made using SIS digital reversing thermometers. Two or three instruments were mounted together in a reversing cage to provide duplicate data and an indication of occasions when the cage had failed to reverse cleanly. Each thermometer was periodically calibrated at the RVS laboratory facility and a correction, in the form of a third order polynomial, determined. These corrections were routinely applied. Data in the database are the averages of the readings from all thermometers in the

cage after fliers (such as caused by the reading being written down incorrectly) have been eliminated.

Salinity samples were taken in medicine bottles. After rinsing, the bottle was filled up to the shoulder, carefully dried off and then sealed with a plastic stopper under the cap. Salinities were determined by taking triplicate readings on a Guildline Autosol bench salinometer as soon as the samples had come to laboratory temperature (generally 24-36 hours after sampling). The instrument was standardised against OSI standard seawater.

Dr. Antonio Bode

Salinity bottle data were supplied for ST0898. However, these were not analysed until a year after the cruise and visible signs of sample deterioration were reported. Consequently, their accuracy is seriously questioned.

A Neil Brown Mk 3B CTD was used. Temperatures have been assumed to be accurate. The ST0898 salinity data were calibrated against a credible subset of the bottle data and deep T/S curves. A salinity calibration (from the next cruise, but using the same CTD) was supplied for TH1099.

Dr. João Vitorino

A Neil Brown Mk 3C CTD was used. The data were fully worked up, including salinity calibration against bottle data (not supplied), by the data originator.

Comments on Data Quality

The bottle data are believed to be good quality except for ST0898. Individual values identified as suspect during CTD calibration procedures have been flagged in the database.

All CTD temperature data are believed to be of acceptable accuracy and may be used with confidence in applications where a guaranteed accuracy of 0.01°C is required. Accuracy may be significantly better than this, but there are no data to prove it.

The quality of the CTD salinity data varies from cruise to cruise, but in all cases accuracy is believed to be better than 0.02 PSU. The cruises with better accuracy are Belgica, Pelagia, Charles Darwin CD105 and CD110, Meteor and Almeida Carvalho. Accuracy for these cruises is of the order of 0.005 PSU.

Further details of calibration procedures and the quality of the results may be found in the CTD data documentation.

Irradiance

Parameter Code Definitions

IRRDPP01	Downwelling 2-pi scalar PAR irradiance Hemispherical photodiode light meter MicroEinsteins/square metre/second
IRRUPP01	Upwelling 2-pi scalar PAR irradiance Hemispherical photodiode light meter MicroEinsteins/square metre/second
LVLTPD01	PML 2-pi PAR scalar light meter output voltage (downwelling configuration) Output voltage sampled by analogue to digital converter Volts
LVLTPU01	PML 2-pi PAR scalar light meter output voltage (upwelling configuration) Output voltage sampled by analogue to digital converter Volts

Originator Code Definitions

Charles Darwin cruises **CD105B, CD110A, CD110B, CD114A and CD114B**

16

British Oceanographic Data Centre

Originator Protocols

British Oceanographic Data Centre

The data presented in the BOTDATA table are derived from CTD **downcast** data at the bottle firing depths. Note that the interpolation was done on log transformed data to allow a linear technique to be used.

The data were collected by Plymouth Marine Laboratory designed light meters based on a photodiode under a hemispherical translucent white plastic cap. The sensors were designed to collect light across the visible portion of the spectrum.

The light meters were fitted to the CTD frame with the downwelling instrument projecting above the top of the bottle rosette and the upwelling instrument attached to the base of the cage. This gave a physical separation of approximately two metres.

The data were logged as voltages and converted to W/m^2 using laboratory calibrations. Note that the instruments were rebuilt and recalibrated during the summer of 1995. The data were converted to $\mu\text{E/m}^2/\text{s}$ using an empirically derived conversion factor of 3.75.

Volume of Water Filtered

Parameter Code Definitions

VOLFFMXX Volume filtered
Flow meter
Litres

VOLFMCXX Volume filtered
Measuring cylinder
Litres

Originator Code Definitions

Belgica cruises BG9714C, BG9714D, BG9815C, BG9815D, BG9919A, BG9919B and BG9919C

14 Dr. Lei Chou ULB, Brussels, Belgium

Pelagia cruise PLG109 and PLG138

75 Dr. Tjeerd van Weering NIOZ, Texel, the Netherlands

Charles Darwin cruise CD105B

15 Prof. Nick McCave Cambridge University, UK

Originator Protocols

Dr. Lei Chou

The volumes filtered during a stand-alone pump (SAP) deployments were measured by reading the flow meter on the instrument before and after deployment.

Flow rate to the centrifuge was controlled and monitored. The volume filtered was estimated from the flow rate and the sampling duration.

Dr. Tjeerd van Weering and Prof. Nick McCave

The volume filtered for SPM determinations was recorded and has been included in the database as it gives an indication of data quality.

Comments on Data Quality

The volume filtered parameter is only included as an indication of the quantity of water sampled and should not be used for quantitative purposes. In particular, SAP filters are prone to bursting. A burst filter will use perfectly adequate material for determination of suspended particulate material composition, but the volume filtered will be a gross overestimate.

Microzooplankton Biomass and Grazing

Parameter Code Definitions

GRAZDDMZ	Microzooplankton grazing coefficient Dilution experiment (shipboard incubation of 200 micron screened water) Per day
MZBCMITX	Total microzooplankton biomass (expressed as carbon) Calculated from cell counts determined by optical microscopy milligrams/cubic metre
MZBNMITX	Total microzooplankton abundance (cell numbers) Optical microscopy Number per millilitre
PHYGDDTX	Phytoplankton growth coefficient Dilution experiment (shipboard incubation of 200 micron screened water) Per day

Originator Code Definitions

Belgica cruise BG9815C, Poseidon cruise PS237_1, Charles Darwin cruises CD110B, CD114A and CD114B and Professor Shtokman cruise ST0898

137 Dr. Elaine Fileman

Plymouth Marine Laboratory, UK

Originator Protocols

Dr. Elaine Fileman

Water samples were obtained from water bottles deployed on a CTD rosette. These were fixed with 1% Lugol's iodine and the microzooplankton were counted using an image analysis system coupled to an inverted microscope. Fixed samples were gently mixed and sub-samples of 30-100 ml were concentrated overnight in sedimentation chambers. Each sample was examined at a magnification of x300 and all grazers > circa 10 microns were counted. Cells were identified to genus level whenever possible. In order to obtain a more accurate identification of some ciliates, Protargol silver staining was carried out on a number of samples

The biomass was determined using methods detailed in JGOFS protocols (Burkill et al., 1994). The image analysis system was used to generate data on the surface area of each cell. These were converted to cell volume using geometric formulae and standard volume to carbon conversion factors were applied for different taxa. Individual cell carbon volumes were integrated for discrete taxa to determine the biomass of those taxa in each water sample.

Natural microbial populations were incubated either in-situ or on board ship using the 'dilution technique described by Landry and Hassett (1982). Time course experiments were run under different dilutions and the specific growth of phytoplankton determined. Water samples were collected at dawn from a depth of 10m using 30 litre Niskin bottles. Half of this water was filtered using a Gelman 0.2 micron mini capsule filter. A known volume of this 'predator and prey free' water was added to polycarbonate bottles. Each bottle was gently topped up with 200 micron screened, unfiltered water generating triplicate dilutions of 100%, 70%, 40% and 10%. Incubation was carried out over 24 hours. Sub-samples were taken from each bottle at T0 and T24 for determination of chlorophyll and fixation in Lugol's iodine for estimation of microzooplankton abundance. Chlorophyll was determined by extraction of 90% acetone, using a highly sensitive fluorometer. Phytoplankton mortality due to grazing was determined from alteration in the specific growth rate.

Phytoplankton Group and Cyanobacteria Abundance and Biomass

Parameter Code Definitions

C200E00A	Heterotrophic dinoflagellate (<20µm) biomass as carbon Epifluorescence with DAPI/Proflavine stain Milligrams/cubic metre
C400E00Q	Heterotrophic nanoflagellate (5-20µm) biomass as carbon Epifluorescence with DAPI/Proflavine stain Milligrams/cubic metre
C400E00R	Heterotrophic + autotrophic nanoflagellate (2-5µm) biomass as carbon Epifluorescence with DAPI/Proflavine stain Milligrams/cubic metre
C400E00S	Heterotrophic (2-20µm) plus autotrophic (2-5µm) biomass as carbon Epifluorescence with DAPI/Proflavine stain Milligrams/cubic metre
CBBMMFTX	Cyanobacteria biomass as carbon Calculated from cell counts determined by autofluorescence microscopy (unstained fresh sample) Milligrams/cubic metre
CBCCMFTX	Cyanobacteria abundance Autofluorescence microscopy (unstained fresh sample) Number per millilitre
CBCCMPTD	Number of cyanobacteria cells in division Autofluorescence microscopy (unstained preserved sample) Number per millilitre
CBCCMPTX	Cyanobacteria abundance Autofluorescence microscopy (unstained preserved sample) Number per millilitre
CTPPCVXX	Total phytoplankton biomass as carbon Computed from individual taxa abundance and literature carbon conversion factors Milligrams/cubic metre

P200E00A	Heterotrophic dinoflagellate (<20µm) abundance Epifluorescence with DAPI/Proflavine stain Number per millilitre
P400E00K	Autotrophic picoflagellate (<2µm) abundance Epifluorescence microscopy Number per millilitre
P400E00L	Autotrophic nanoflagellate (2-5µm) abundance Epifluorescence microscopy Number per millilitre
P400E00M	Autotrophic nanoflagellate (5-10µm) abundance Epifluorescence microscopy Number per millilitre
P400E00N	Autotrophic nanoflagellate (10-20µm) abundance Epifluorescence microscopy Number per millilitre
P400E00Q	Heterotrophic nanoflagellate (5-20µm) abundance Epifluorescence with DAPI/Proflavine stain Number per millilitre
P400E00R	Heterotrophic + autotrophic nanoflagellate (2-5µm) biomass as carbon Epifluorescence with DAPI/Proflavine stain Number per millilitre

Originator Code Definitions

Charles Darwin cruise CD114A

137	Dr. Elaine Fileman	Plymouth Marine Laboratory, UK
163	Dr. F. G. Figueiras	IIM, Vigo, Spain

Charles Darwin cruise CD114B and Poseidon cruise PS237_1

137	Dr. Elaine Fileman	Plymouth Marine Laboratory, UK
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Belgica cruise BG9714C and Charles Darwin cruise CD110B

163	Dr. F. G. Figueiras	IIM, Vigo, Spain
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Originator Protocols

Dr. Elaine Fileman

Samples were also collected for the determination of nanoplankton (2-20 micron) abundance and biomass. Samples were fixed in 0.3% glutaraldehyde, dual stained with DAPI and proflavine and filtered onto 0.4 micron black polycarbonate filters. Cells were counted by epifluorescence microscopy. Heterotrophs were distinguished from autotrophs by the presence or absence of chlorophyll autofluorescence, although this was not always possible. 1-200 flagellate cells were counted per filter and cell dimensions were measured with an ocular micrometer. Flagellate cell volumes were calculated assuming they were ellipsoids. Biovolumes were converted to biomass using appropriate carbon conversion factors.

Live video work together with fluorescence microscopy at sea enabled the separation of heterotrophic dinoflagellates from phototrophic forms. All ciliates were assumed to be heterotrophic.

Dr. F. G. Figueiras

The total count of autotrophic cyanobacteria, cyanobacteria and cyanobacteria in division, picoflagellates and nanoflagellates were determined in water samples fixed with formalin (final concentration 4%). Epifluorescence microscopy on 0.2 μm black Millipore polycarbonate filters was used.

The dimensions of each autotrophic phytoplankton species identified were measured and cell volumes were determined by approximation to the nearest geometric shape (Edler 1979). The plasma volume of diatoms and biovolume of flagellates, dinoflagellates and *Mesodinium rubrum* were converted to carbon contents using the conversion factor of Strathmann (1967) as follows:

Diatom $\text{Log}_{10} C = 0.892 (\text{log}_{10} VP) - 0.61$.

Flagellates, dinoflagellates & *Mesodinium rubrum* = $0.866 (\text{log}_{10} V) - 0.46$.

Where VP is the plasma volume (μm^3), V is the total cell volume (μm^3), and C is the carbon content (pg cell^{-1}). Cyanobacteria and nanoflagellate biomass was converted to carbon using the conversion factor of 0.25 from Booth (1988) for Cyanobacteria and 0.22 from Kana and Gilbert (1987) for nanoflagellates. Total cell volume of picoflagellates was converted to carbon content using:

Picoflagellates $C = 0.433(BV)^{0.863}$

from Verity et al. (1992) where Bv is the cell volume (μm^3).

Phytoplankton Species Counts

Parameter Code Definitions

P000M01A	Diatoms (centric <30µm) abundance	per ml
P000M01B	Diatoms (centric >30µm) abundance	per ml
P000M01C	Diatoms (centric large) abundance	per ml
P000M01D	Diatoms (centric medium size) abundance	per ml
P000M01E	Diatoms (centric small) abundance	per ml
P000M01Z	Diatoms (centric) abundance	per ml
P000M02A	Diatoms (pennate <30µm) abundance	per ml
P000M02B	Diatoms (pennate >30µm) abundance	per ml
P000M02D	Diatoms (pennate small) abundance	per ml
P001M01Z	Achnanthes taeniata abundance	per ml
P011M04Z	Asterionella japonica abundance	per ml
P011M05Z	Asterionella mediterranea abundance	per ml
P012M00Z	Asteromphalus spp. abundance	per ml
P017M01Z	Bacillaria paxillifer abundance	per ml
P018M00B	Bacteriastrium spp. (medium size) abundance	per ml
P018M03Z	Bacteriastrium delicatulum abundance	per ml
P021M06Z	Biddulphia mobiliensis abundance	per ml
P028M01Z	Cerataulina pelagica abundance	per ml
P028M02Z	Cerataulina bergonii abundance	per ml
P030M00E	Chaetoceros spp. (medium size) abundance	per ml
P030M00Z	Chaetoceros spp. abundance	per ml
P030M01Z	Chaetoceros affine abundance	per ml
P030M02Z	Chaetoceros atlanticum abundance	per ml
P030M05Z	Chaetoceros breve abundance	per ml
P030M09Z	Chaetoceros compressum abundance	per ml
P030M11Z	Chaetoceros constrictum abundance	per ml
P030M12Z	Chaetoceros convolutum abundance	per ml
P030M14Z	Chaetoceros costatum abundance	per ml
P030M16Z	Chaetoceros curvisetum abundance	per ml
P030M17Z	Chaetoceros danicum abundance	per ml
P030M19Z	Chaetoceros decipiens abundance	per ml
P030M20Z	Chaetoceros densum abundance	per ml
P030M21Z	Chaetoceros didymum abundance	per ml
P030M23Z	Chaetoceros diadema abundance	per ml
P030M38Z	Chaetoceros lorenzianum abundance	per ml
P030M43Z	Chaetoceros peruvianum abundance	per ml
P030M48Z	Chaetoceros radicans abundance	per ml
P030M56Z	Chaetoceros sociale abundance	per ml
P030M57Z	Chaetoceros subsecundum abundance	per ml
P030M59Z	Chaetoceros teres abundance	per ml
P030M62Z	Chaetoceros wighami abundance	per ml
P030M74Z	Chaetoceros debilis abundance	per ml

P030M75Z	Chaetoceros lauderi abundance	per ml
P030M77Z	Chaetoceros similis abundance	per ml
P030M96Z	Chaetoceros gracilis abundance	per ml
P030M97Z	Chaetoceros pseudocurvisetus abundance	per ml
P030M98Z	Chaetoceros vistulae abundance	per ml
P032M00Z	Cocconeis spp. abundance	per ml
P033M01Z	Corethron criophilum abundance	per ml
P033M05Z	Corethron hystrix abundance	per ml
P033M10Z	Corethron pelagicum abundance	per ml
P034M00B	Coscinodiscus spp. (medium size) abundance	per ml
P034M00Z	Coscinodiscus spp. abundance	per ml
P034M13Z	Coscinodiscus lineatum abundance	per ml
P034M24Z	Coscinodiscus radiatus abundance	per ml
P038M00Z	Cymatosira spp. abundance	per ml
P038M05Z	Cymatosira lorenziana abundance	per ml
P039M03Z	Dactyliosolen mediterraneus abundance	per ml
P039M04A	Dactyliosolen fragilissima (small) abundance	per ml
P039M04Z	Dactyliosolen fragilissima abundance	per ml
P043M10Z	Diploneis cabro abundance	per ml
P044M01Z	Ditylum brightwellii abundance	per ml
P048M01Z	Eucampia zodiacus abundance	per ml
P056M25Z	Grammatophora marina abundance	per ml
P058M01Z	Guinardia flaccida abundance	per ml
P058M25Z	Guinardia striata abundance	per ml
P059M00C	Gyrosigma spp. (small) abundance	per ml
P061M01Z	Hemiaulus hauckii abundance	per ml
P061M10Z	Hemiaulus sinensis abundance	per ml
P067M01Z	Lauderia borealis abundance	per ml
P067M02Z	Lauderia annulata abundance	per ml
P068M01Z	Leptocylindrus danicus abundance	per ml
P068M02Z	Leptocylindrus mediterranea abundance	per ml
P068M03Z	Leptocylindrus minimus abundance	per ml
P072M50Z	Lioloma pacificum abundance	per ml
P073M00A	Navicula spp. (large) abundance	per ml
P073M00B	Navicula spp. (medium size) abundance	per ml
P073M00C	Navicula spp. (small) abundance	per ml
P073M00P	Navicula spp. (>30µm) abundance	per ml
P073M00Z	Navicula spp. abundance	per ml
P073M07Z	Navicula membranacea abundance	per ml
P073M50A	Navicula transitrans var. derasa abundance	per ml
P073M50B	Navicula transitrans var. derasa delicatula abundance	per ml
P073M59Z	Navicula distans abundance	per ml
P073M70Z	Navicula ostrearia abundance	per ml
P073M80Z	Navicula salinarum abundance	per ml
P073M85Z	Navicula wawriake abundance	per ml
P074M00Z	Nitzschia spp. abundance	per ml
P074M14Z	Nitzschia closterium abundance	per ml
P074M49Z	Nitzschia pacifica abundance	per ml
P074M58A	Nitzschia pungens acuta abundance	per ml
P074M58Z	Nitzschia pungens abundance	per ml

P074M72A	Nitzschia longissima petite abundance	per ml
P074M72Z	Nitzschia longissima abundance	per ml
P078M01Z	Paralia sulcata abundance	per ml
P081M01Z	Planktoniella sol abundance	per ml
P084M00C	Pleurosigma spp. (small) abundance	per ml
P084M00Z	Pleurosigma spp. abundance	per ml
P084M02Z	Pleurosigma acutum abundance	per ml
P084M15Z	Pleurosigma elongatum abundance	per ml
P086M02Z	Podosira stelliger abundance	per ml
P093M00A	Rhizosolenia spp. (large) abundance	per ml
P093M00B	Rhizosolenia spp. (medium size) abundance	per ml
P093M02B	Rhizosolenia alata gracilima abundance	per ml
P093M02C	Rhizosolenia alata indica abundance	per ml
P093M02Z	Rhizosolenia alata abundance	per ml
P093M06Z	Rhizosolenia bergonii abundance	per ml
P093M09Z	Rhizosolenia cylindrus abundance	per ml
P093M12Z	Rhizosolenia delicatula abundance	per ml
P093M13Z	Rhizosolenia fragilissima abundance	per ml
P093M14A	Rhizosolenia hebetata hebetata abundance	per ml
P093M14B	Rhizosolenia hebetata hiemalis abundance	per ml
P093M14Z	Rhizosolenia hebetata abundance	per ml
P093M16A	Rhizosolenia imbricata shrubsolei abundance	per ml
P093M16Z	Rhizosolenia imbricata abundance	per ml
P093M20Z	Rhizosolenia robusta abundance	per ml
P093M21Z	Rhizosolenia setigera abundance	per ml
P093M22Z	Rhizosolenia shrubsolei abundance	per ml
P093M23Z	Rhizosolenia stolterfothii abundance	per ml
P093M24A	Rhizosolenia styliformis var. longispina abundance	per ml
P093M24Z	Rhizosolenia styliformis abundance	per ml
P098M01A	Schroederella delicatula var. shrubsolei abundance	per ml
P098M01Z	Schroederella delicatula abundance	per ml
P101M01Z	Skeletonema costatum abundance	per ml
P105M02Z	Stephanopyxis turris abundance	per ml
P110M00Z	Thalassionema spp. abundance	per ml
P110M01Z	Thalassionema nitzschioides abundance	per ml
P110M02Z	Thalassionema bacillaris abundance	per ml
P111M00J	Thalassiosira spp. (small) abundance	per ml
P111M00L	Thalassiosira spp. (medium size) abundance	per ml
P111M00Z	Thalassiosira spp. abundance	per ml
P111M06Z	Thalassiosira decipiens abundance	per ml
P111M08Z	Thalassiosira fallax abundance	per ml
P111M10Z	Thalassiosira gravida abundance	per ml
P111M12Z	Thalassiosira levanderi abundance	per ml
P111M13Z	Thalassiosira nordenskioldii abundance	per ml
P111M17Z	Thalassiosira rotula abundance	per ml
P111M18Z	Thalassiosira subtilis abundance	per ml
P111M93Z	Thalassiosira anguste-lineata abundance	per ml
P111M94Z	Thalassiosira nana abundance	per ml
P112M01Z	Thalassiothrix frauenfeldii abundance	per ml
P114M00Z	Trachyneis spp. abundance	per ml

P118M00Z	Tropidoneis spp. abundance	per ml
P118M10Z	Tropidoneis lepidoptera abundance	per ml
P189M20Z	Meuniera membranacea abundance	per ml
P191M05Z	Proboscia alata abundance	per ml
P196M10Z	Coscinosira oestrupii abundance	per ml
P196M20Z	Coscinosira polychorda abundance	per ml
P197M00B	Pseudo-nitzschia spp. (medium size) abundance	per ml
P197M00Z	Pseudo-nitzschia spp. abundance	per ml
P197M05Z	Pseudo-nitzschia delicatissima abundance	per ml
P197M08A	Pseudo-nitzschia longissima (small) abundance	per ml
P197M08Z	Pseudo-nitzschia longissima abundance	per ml
P197M09Z	Pseudo-nitzschia pacifica abundance	per ml
P197M10A	Pseudo-nitzschia pungens var. auxospore abundance	per ml
P197M10B	Pseudo-nitzschia pungens (small) abundance	per ml
P197M10Z	Pseudo-nitzschia pungens abundance	per ml
P197M20Z	Pseudo-nitzschia seriata abundance	per ml
P199M02Z	Melosira moniliformis abundance	per ml
P199M04Z	Melosira sulcata abundance	per ml
P200M00C	Dinoflagellates (armoured: small) abundance	per ml
P200M00D	Dinoflagellates (<30µm) abundance	per ml
P200M00E	Dinoflagellates (>30µm) abundance	per ml
P200M00F	Dinoflagellates (naked: medium size) abundance	per ml
P200M00G	Dinoflagellates (naked: small) abundance	per ml
P200M00H	Dinoflagellates (medium: armoured) abundance	per ml
P200M90Z	Dinoflagellate cysts abundance	per ml
P203M00B	Alexandrium spp. (medium size) abundance	per ml
P205M00A	Amphidinium spp. (large) abundance	per ml
P205M00B	Amphidinium spp. (small) abundance	per ml
P205M00C	Amphidinium spp. (medium size) abundance	per ml
P205M00Z	Amphidinium spp abundance	per ml
P205M01Z	Amphidinium carterae abundance	per ml
P205M02Z	Amphidinium curvatum abundance	per ml
P205M03Z	Amphidinium flagellans abundance	per ml
P205M04Z	Amphidinium operculatum abundance	per ml
P205M05Z	Amphidinium sphenoides abundance	per ml
P205M06Z	Amphidinium acutissimum abundance	per ml
P205M07Z	Amphidinium amphidinoides abundance	per ml
P206M02Z	Amphidoma caudatum abundance	per ml
P207M00Z	Amphisolenia spp. abundance	per ml
P207M10Z	Amphisolenia spinulosa abundance	per ml
P212M01Z	Cachonina niei abundance	per ml
P212M02Z	Cachonina hallii abundance	per ml
P213M00A	Ceratium arietinum gracilentum abundance	per ml
P213M01A	Ceratium spp. (large) abundance	per ml
P213M01B	Ceratium spp. (medium size) abundance	per ml
P213M01Z	Ceratium spp. abundance	per ml
P213M03Z	Ceratium azoricum abundance	per ml
P213M04Z	Ceratium candelabrum abundance	per ml
P213M08Z	Ceratium furca abundance	per ml
P213M09Z	Ceratium fusus abundance	per ml

P213M10Z	<i>Ceratium gibberum</i> abundance	per ml
P213M13Z	<i>Ceratium horridum</i> abundance	per ml
P213M15Z	<i>Ceratium lineatum</i> abundance	per ml
P213M18Z	<i>Ceratium macroceros</i> abundance	per ml
P213M20Z	<i>Ceratium minutum</i> abundance	per ml
P213M21Z	<i>Ceratium pentagonum</i> abundance	per ml
P213M22Z	<i>Ceratium platycorne</i> abundance	per ml
P213M25Z	<i>Ceratium pulchellum</i> abundance	per ml
P213M26Z	<i>Ceratium tripos</i> abundance	per ml
P213M31Z	<i>Ceratium limulus</i> abundance	per ml
P213M32Z	<i>Ceratium lunula</i> abundance	per ml
P213M34Z	<i>Ceratium teres</i> abundance	per ml
P213M35Z	<i>Ceratium trichoceros</i> abundance	per ml
P213M40Z	<i>Ceratium bucephalum</i> abundance	per ml
P213M41Z	<i>Ceratium buceros</i> abundance	per ml
P213M42Z	<i>Ceratium simmetricum</i> abundance	per ml
P213M43Z	<i>Ceratium concilians</i> abundance	per ml
P213M95Z	<i>Ceratium arcticum</i> abundance	per ml
P219M00B	<i>Dinophysis</i> spp. (medium size) abundance	per ml
P219M00C	<i>Dinophysis</i> spp. (small) abundance	per ml
P219M00Z	<i>Dinophysis</i> spp. abundance	per ml
P219M01Z	<i>Dinophysis acuminata</i> abundance	per ml
P219M02Z	<i>Dinophysis acuta</i> abundance	per ml
P219M07A	<i>Dinophysis caudata</i> var. <i>abbreviata</i> abundance	per ml
P219M07Z	<i>Dinophysis caudata</i> abundance	per ml
P219M11Z	<i>Dinophysis diegensis</i> abundance	per ml
P219M12Z	<i>Dinophysis fortii</i> abundance	per ml
P219M14Z	<i>Dinophysis hastata</i> abundance	per ml
P219M32Z	<i>Dinophysis sacculus</i> abundance	per ml
P219M35Z	<i>Dinophysis schroederi</i> abundance	per ml
P226M00B	<i>Goniodoma</i> spp. (medium size) abundance	per ml
P226M00Z	<i>Goniodoma</i> spp. abundance	per ml
P226M10Z	<i>Goniodoma polyedricum</i> abundance	per ml
P226M20Z	<i>Goniodoma sphaericum</i> abundance	per ml
P228M00B	<i>Gonyaulax</i> spp. (medium size) abundance	per ml
P228M06Z	<i>Gonyaulax diegensis</i> abundance	per ml
P228M17Z	<i>Gonyaulax polygramma</i> abundance	per ml
P228M19Z	<i>Gonyaulax spinifera</i> abundance	per ml
P229M00A	<i>Gymnodinium</i> spp. (medium size) abundance	per ml
P229M00B	<i>Gymnodinium</i> spp. (small) abundance	per ml
P229M05Z	<i>Gymnodinium agiliforme</i> abundance	per ml
P229M10Z	<i>Gymnodinium aureolum</i> abundance	per ml
P229M20Z	<i>Gymnodinium hamulus</i> abundance	per ml
P229M30Z	<i>Gymnodinium nanum</i> abundance	per ml
P229M50Z	<i>Gymnodinium splendens</i> abundance	per ml
P229M55Z	<i>Gymnodinium simplex</i> abundance	per ml
P229M60Z	<i>Gymnodinium varians</i> abundance	per ml
P230M00B	<i>Gyrodinium</i> spp. (large) abundance	per ml
P230M00C	<i>Gyrodinium</i> spp. (medium size) abundance	per ml
P230M00D	<i>Gyrodinium</i> spp. (small) abundance	per ml

P230M00Z	Gyrodinium spp. abundance	per ml
P230M04Z	Gyrodinium britannicum abundance	per ml
P230M14Z	Gyrodinium fusiforme abundance	per ml
P230M15Z	Gyrodinium glaucum abundance	per ml
P230M27C	Gyrodinium spirale (small) abundance	per ml
P230M27Z	Gyrodinium spirale abundance	per ml
P237M00Z	Heterodinium spp. abundance	per ml
P252M00B	Phalacroma spp. (medium size) abundance	per ml
P252M00C	Phalacroma spp. (small) abundance	per ml
P252M00Z	Phalacroma spp. abundance	per ml
P252M10Z	Phalacroma parvum abundance	per ml
P257M00A	Prorocentrum spp. (medium size) abundance	per ml
P257M00B	Prorocentrum spp. (large) abundance	per ml
P257M00C	Prorocentrum spp. (small) abundance	per ml
P257M02Z	Prorocentrum balticum abundance	per ml
P257M04Z	Prorocentrum compressum abundance	per ml
P257M06Z	Prorocentrum gracile abundance	per ml
P257M08Z	Prorocentrum micans abundance	per ml
P257M09Z	Prorocentrum minimum abundance	per ml
P257M12Z	Prorocentrum rostratum abundance	per ml
P266M00C	Scrippsiella spp. (small) abundance	per ml
P266M01Z	Scrippsiella faeroense abundance	per ml
P266M02Z	Scrippsiella trochoidea abundance	per ml
P275M50Z	Triadinium polyedricum abundance	per ml
P276M20Z	Murrayella biconica abundance	per ml
P315M00B	Cochlodinium spp. (medium size) abundance	per ml
P315M00C	Cochlodinium spp. (small) abundance	per ml
P315M00Z	Cochlodinium spp. abundance	per ml
P315M03Z	Cochlodinium brandtii abundance	per ml
P315M05Z	Cochlodinium helix abundance	per ml
P321M00Z	Diplopsalis spp. abundance	per ml
P321M01Z	Diplopsalis assimetrica abundance	per ml
P349M00A	Oxytoxum spp.(medium size) abundance	per ml
P349M00B	Oxytoxum spp. (small) abundance	per ml
P349M00C	Oxytoxum spp. (large) abundance	per ml
P349M00Z	Oxytoxum spp. abundance	per ml
P349M01Z	Oxytoxum scolopax abundance	per ml
P349M04Z	Oxytoxum constrictum abundance	per ml
P349M05Z	Oxytoxum gracile abundance	per ml
P349M06Z	Oxytoxum sceptrum abundance	per ml
P349M08Z	Oxytoxum tessellatum abundance	per ml
P349M09Z	Oxytoxum variabile abundance	per ml
P349M10Z	Oxytoxum viride abundance	per ml
P349M96Z	Oxytoxum parvum abundance	per ml
P349M97Z	Oxytoxum crassum abundance	per ml
P349M98Z	Oxytoxum sphaeroideum abundance	per ml
P349M99Z	Oxytoxum caudatum abundance	per ml
P353M02Z	Podolampas palmipes abundance	per ml
P353M10Z	Podolampas spinifer abundance	per ml
P356M00Z	Pronoctiluca spp. abundance	per ml

P356M05Z	Pronoctiluca acuta abundance	per ml
P358M06Z	Protooperidinium bipes abundance	per ml
P358M08Z	Protooperidinium brevipes abundance	per ml
P358M13Z	Protooperidinium conicum abundance	per ml
P358M15Z	Protooperidinium curtipes abundance	per ml
P358M20Z	Protooperidinium depressum abundance	per ml
P358M21Z	Protooperidinium diabolum abundance	per ml
P358M33Z	Protooperidinium leonis abundance	per ml
P358M42Z	Protooperidinium oceanicum abundance	per ml
P358M43Z	Protooperidinium ovatum abundance	per ml
P358M54Z	Protooperidinium steinii abundance	per ml
P358M58Z	Protooperidinium tuba abundance	per ml
P360M01Z	Ptychodiscus noctiluca abundance	per ml
P361M00B	Pyrocystis spp. (medium size) abundance	per ml
P361M01Z	Pyrocystis lunula abundance	per ml
P361M03Z	Pyrocystis fusiformis abundance	per ml
P363M01Z	Pyrophacus horologium abundance	per ml
P366M01A	Peridinium spp. (large) abundance	per ml
P366M01B	Peridinium spp. (medium size) abundance	per ml
P366M01C	Peridinium spp. (small) abundance	per ml
P366M01Z	Peridinium spp. abundance	per ml
P366M83Z	Peridinium pentagonum abundance	per ml
P366M84Z	Peridinium divergens abundance	per ml
P366M85Z	Peridinium tuba abundance	per ml
P366M87Z	Peridinium murray abundance	per ml
P366M88Z	Peridinium mite abundance	per ml
P366M89Z	Peridinium leonis abundance	per ml
P366M90Z	Peridinium cerasus abundance	per ml
P366M91Z	Peridinium atlanticum abundance	per ml
P366M92Z	Peridinium steinii abundance	per ml
P366M93Z	Peridinium pellucidum abundance	per ml
P366M94Z	Peridinium minutum abundance	per ml
P366M95Z	Peridinium minusculum abundance	per ml
P366M96Z	Peridinium diabolum abundance	per ml
P366M97Z	Peridinium depressum abundance	per ml
P366M98Z	Peridinium brochi abundance	per ml
P370M00A	Torodinium spp. (small) abundance	per ml
P370M01C	Torodinium robustum (small) abundance	per ml
P370M01Z	Torodinium robustum abundance	per ml
P400M00I	Flagellates (small) abundance	per ml
P401M01A	Monads (>10µm) abundance	per ml
P404M00Z	Cryptophytes (Cryptophyceae) abundance	per ml
P404M04Z	Cryptomonad abundance	per ml
P424M00B	Dictyocha spp. (medium size) abundance	per ml
P424M01Z	Dictyocha fibula abundance	per ml
P424M15Z	Dictyocha speculum abundance	per ml
P436M01Z	Phaeocystis pouchetii abundance	per ml
P500M17A	Ciliates (<30µm) abundance	per ml
P500M17B	Ciliates (>30µm) abundance	per ml
P500M17C	Ciliates (>100µm) abundance	per ml

P521M20Z	Mesodinium pulex abundance	per ml
P521M30Z	Mesodinium rubrum abundance	per ml
P525M25Z	Dadayiella jorgensinii abundance	per ml
P965M00Z	Radiolaria spp. abundance	per ml
P966M00A	Tintinnopsis spp. (large) abundance	per ml
P966M00Z	Tintinnopsis spp. abundance	per ml
P966M07Z	Tintinnopsis stenosemella abundance	per ml
P966M08B	Tintinnopsis steenstrupiella steenstrupii abundance	per ml
P967M00Z	Tetraselmis spp. abundance	per ml
P968M00A	Strobilidium spp. (medium size) abundance	per ml
P968M00B	Strobilidium spp. (small) abundance	per ml
P968M10Z	Strobilidium elegans abundance	per ml
P968M30Z	Strobilidium oligotrichus abundance	per ml
P969M30Z	Solenicola setigera abundance	per ml
P971M00A	Peritrichous (medium size) abundance	per ml
P971M00B	Peritrichous (small) abundance	per ml
P971M00D	Peritrichous (large round) abundance	per ml
P972M00A	Oligotrichs (large) abundance	per ml
P972M00B	Oligotrichs (medium size) abundance	per ml
P972M00C	Oligotrichs (small) abundance	per ml
P973M10C	Metastrombidium sonniffer (small) abundance	per ml
P973M10Z	Metastrombidium sonniffer abundance	per ml
P974M00A	Lohmaniella spp. (large) abundance	per ml
P974M20B	Lohmaniella spiralis (medium) abundance	per ml
P974M20C	Lohmaniella spiralis (small) abundance	per ml
P974M20Z	Lohmaniella spiralis abundance	per ml
P975M00Z	Leucocryptos spp. abundance	per ml
P976M20Z	Laboea reticulata abundance	per ml
P976M40Z	Laboea strobila abundance	per ml
P977M05Z	Heterosigma akashiwo abundance	per ml
P978M00Z	Eutreptiella spp. abundance	per ml
P979M00Z	Eutreptia spp. abundance	per ml
P985M00A	Strombidium spp. (large) abundance	per ml
P985M00B	Strombidium spp. (small) abundance	per ml
P985M00C	Strombidium spp. (medium) abundance	per ml
P985M06Z	Strombidium conicoides abundance	per ml
P985M08Z	Strombidium constrictum abundance	per ml
P985M10Z	Strombidium cornutum abundance	per ml
P985M12Z	Strombidium coronatum abundance	per ml
P985M13Z	Strombidium crassulum abundance	per ml
P985M14Z	Strombidium delicatissimum abundance	per ml
P985M16Z	Strombidium elegans abundance	per ml
P985M30Z	Strombidium minutum abundance	per ml
P985M32Z	Strombidium mirabile abundance	per ml
P985M35Z	Strombidium oculatum abundance	per ml
P985M36Z	Strombidium reticulatum abundance	per ml
P985M37Z	Strombidium sonnifer abundance	per ml
P985M40Z	Strombidium styliifer abundance	per ml
P985M42Z	Strombidium sulcatum abundance	per ml
P985M44Z	Strombidium symbioticum abundance	per ml

P985M46Z	Strombidium testaceum abundance	per ml
P985M48Z	Strombidium turbo abundance	per ml
P985M50Z	Strombidium typicum abundance	per ml
P985M55Z	Strombidium vestitum abundance	per ml
P985M60Z	Strombidium viride abundance	per ml
P985M99Z	Strombidium curnocopiae abundance	per ml
P988M00B	Ornithocerus spp. (medium size) abundance	per ml
P988M00C	Ornithocercus spp. (small) abundance	per ml
P988M03Z	Ornithocercus magnificus abundance	per ml

Originator Code Definitions

Belgica cruises BG9714C, BG9815C, BG9919A, BG9919B and BG9919C, Charles Darwin cruises CD110B, CD114A and CD114B

163 Dr. F. G. Figueiras IIM, Vigo, Spain

Professor Shtokman cruise ST0898 and Thalassa cruise TH1099

134 Dr. Antonio Bode IEO, La Coruña, Spain

Originator Protocols

Parameter Coding Note

A number of species names were reported using the 'cf.' qualifier, indicating that there is some uncertainty in the identification (e.g. Strombidium cf. Constrictum). The data set has been simplified by coding these as if the identification were positive. The example given was coded as P985M08Z, the code for Strombidium constrictum.

Dr. F. G. Figueiras

Water samples for counting and identification of phytoplankton were preserved after collection using Lugol and formaldehyde for analyses under inverted and epifluorescence microscopy respectively.

The data were supplied in units of cells/100ml and have been scaled to cells/ml prior to loading into the database.

Dr. Antonio Bode

Water samples for counting and identification of phytoplankton were preserved after collection using Lugol until later counting by optical microscopy in the laboratory.

Zooplankton Abundance and Copepod Faecal Pellets

Parameter Code Definitions

- FPBVMECA Biovolume of suspended cylindrical faecal pellets (<25 microns diameter)
Inverse microscopy and using stereometrical configurations from Elder (1979)
Cubic microns per millilitre
- FPBVMECB Biovolume of suspended cylindrical faecal pellets (25-40 microns diameter)
Inverse microscopy and using stereometrical configurations from Elder (1979)
Cubic microns per millilitre
- FPBVMECC Biovolume of suspended cylindrical faecal pellets (40-60 microns diameter)
Inverse microscopy and using stereometrical configurations from Elder (1979)
Cubic microns per millilitre
- FPBVMECD Biovolume of suspended cylindrical faecal pellets (60-100 microns diameter)
Inverse microscopy and using stereometrical configurations from Elder (1979)
Cubic microns per millilitre
- FPBVMECE Biovolume of suspended cylindrical faecal pellets (>100 microns diameter)
Inverse microscopy and using stereometrical configurations from Elder (1979)
Cubic microns per millilitre
- FPBVMEEZ Biovolume of suspended ellipsoidal faecal pellets
Inverse microscopy and using stereometrical configurations from Elder (1979)
Cubic microns per millilitre
- FPBVMESZ Biovolume of suspended spherical faecal pellets
Inverse microscopy and using stereometrical configurations from Elder (1979)
Cubic microns per millilitre

Z300O00A	Copepod (large) Optical microscopy Number per litre
Z300O00B	Copepod (medium size) Optical microscopy Number per litre
Z300O00C	Copepod (small) Optical microscopy Number per litre

Originator Code Definitions

Charles Darwin cruise CD110B

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Charles Darwin cruises CD114A and CD114B

61 Dr. Paul Wassmann University of Tromsø, Norway
163 Dr. F. G. Figueiras IIM, Vigo, Spain

Originator Protocols

Dr. F. G. Figueiras

Water samples for counting and identification of phytoplankton were preserved after collection using Lugol and formaldehyde for analyses under inverted and epifluorescence microscopy respectively.

The data were supplied in units of cells/100ml and have been scaled to cells/litre prior to loading into the database.

Dr. Paul Wassmann

Water samples were collected from CTD Niskin bottles on casts taken at either approximately midday ('day experiments') or midnight ('night experiments'). The suspended faecal pellets were concentrated from 20 litres of seawater, using a 20µm sieve. The retained faecal pellets were transferred to 250ml PVC plastic bottles and preserved with glutaraldehyde (4% final concentration), for later identification and counting.

Suspended faecal pellets were enumerated under an inverse microscope according to Utermöhl (1958). The pellets were classified according to their shape as cylindrical, filiform and ellipsoid. Some of these categories were then separated into size classes according to the width and length of the faecal pellet.

The faecal pellet volume (FPV) was calculated using appropriate stereometrical configurations according to Edler (1979). If possible, a minimum of 100 pellets was counted per sample.

The data supplied included faecal pellet biomass expressed in terms of carbon. This was based on the carbon conversion factor of $0.061 \text{ mgC mm}^{-3}$ obtained by González and Smetacek (1994).

Transparent Exopolymer Particle Concentration

Parameter Code Definitions

TEPCSPP2 Transparent exopolymer particle (TEP) concentration as
xanthan equivalent
Spectrophotometric analysis (0.4/0.45 micron pore filtered)
Micrograms per litre

Originator Code Definitions

Charles Darwin cruises CD114A and CD114B

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Originator Protocols

Dr. Paul Wassmann

The TEP was filtered and measured spectrophotometrically according to Passow and Alldredge (1995). Five replicates were taken from each depth and the data presented are the average values. The concentrations are expressed as micrograms xanthan equivalent per litre.

Radionuclides

Parameter Code Definitions

ET34GPD2	Dissolved ^{234}Th activity standard error Gamma spectrometry on purified plated sample (0.45 μm pore filtered) Millibecquerels per litre
ET34GSP2	^{234}Th activity of suspended particulate matter standard error Gamma spectrometry on filter contents (0.45 μm pore filtered) Millibecquerels per litre
T234GPD2	Dissolved ^{234}Th activity Gamma spectrometry on purified plated sample (0.45 μm pore filtered) Millibecquerels per litre
T234GSP2	^{234}Th activity of suspended particulate matter standard error Gamma spectrometry on filter contents (0.45 μm pore filtered) Millibecquerels per litre

Originator Code Definitions

Charles Darwin cruises CD105B and CD110B

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Originator Protocols

Dr. Sabine Schmidt

Water samples (20-60 litres) were filtered through a 0.45 μm Millipore membrane filters. ^{229}Th was added to the water sample with Fe carrier and chemical separation of Th from U was carried out on board, by anion exchange, within 24 hours of sampling.

At the laboratory, particulate ^{234}Th was analysed directly on the filter using a well-type, low background, high efficiency Ge γ -detector. Dissolved Th was further purified by anion-exchange, and evaporated. After dissolution in 0.1M HCl, Th was extracted with TTA in benzene and then plated onto aluminium foil. The chemical yield was determined from α -counting of the ^{229}Th yield

monitor, and dissolved ^{234}Th and ^{228}Th activities were determined by γ -spectrometry.

The data were supplied either as multiple-depth profiles or as 'integrated values' (mean concentrations for the station surface water), resulting from the combination of samples from several depths to get sufficient water for radiochemical analysis. In these cases a nominal depth has been assigned to the samples to allow them to be linked into the database. For CD105B a depth of 30m was chosen. The averaged samples for CD110B were always taken from three depths within the deep winter mixed layer. In this case, the middle depth was chosen.

Current Parameters

Parameter Code Definitions

CSERTFBL	Current speed standard error Thermistor flow meter mounted on a benthic lander Centimetres/second
LCDAEL01	Current direction Eulerian current direction measurement Degrees true towards
LCSATFBL	Current speed Thermistor flow meter mounted on a benthic lander Centimetres/second

Originator Code Definitions

Pelagia cruise PLG121 and Meteor cruise M43_2

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Originator Protocols

Dr. Laurenz Thomsen

The inclusion of current parameters in a water bottle data set may initially seem surprising. However, a benthic water sampling lander collected these data in conjunction with a number of conventional water bottle parameters. Their management as bottle parameters therefore enables all elements of a related data set to be maintained as a single entity.

Water samples were collected using the BIOPROBE benthic water sampling lander (Thomsen et al., 1994). This was gently positioned on the seabed with approximately 20m of slack cable. A graduated rod, monitored by a video camera, determined penetration into the sediment, enabling precise sampling heights to be determined.

The lander was equipped with one or more ADM Instruments thermistor flow meters. Mean current speed and standard error of the current were computed over the duration of the lander deployment. Current directions were determined from video of suspended particles passing over a compass.

These were reported as compass cardinal points, which were digitised by BODC to allow the data to be stored in a numerical database.

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